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REMOVAL SUPPORT TEAM 3
EPA CONTRACT EP-S2-14-01

May 5, 2017

Eric Daly, On-Scene Coordinator
U.S. Environmental Protection Agency
Response & Prevention Branch
2890 Woodbridge Avenue
Edison, NJ 08837

EPA CONTRACT NO: EP-S2-14-01
TDD NO: TO-0007-0011
DOCUMENT CONTROL NO: RST3-03-D-0259
SUBJECT: SITE-SPECIFIC UFP QUALITY ASSURANCE PROJECT PLAN, REVISION 1 – NIAGARA FALLS BOULEVARD RADIOLOGICAL SITE, NIAGARA FALLS, NIAGARA COUNTY, NEW YORK

Dear Mr. Daly,

Enclosed please find the Site-Specific UFP Quality Assurance Project Plan (QAPP) Revision 1, for the Removal Assessment soil sampling activities to be conducted at the Niagara Falls Boulevard Radiological Site located in Niagara Falls, Niagara County, New York. This phase of the assessment is scheduled to begin on May 8 through 12, 2017. If you have any questions or comments, please do not hesitate to contact me at (732) 321-4411.

Sincerely,

Weston Solutions, Inc.

Patrick Buster
RST 3 Site Project Manager

Enclosure
cc: TDD File No.: TO-0007-0011

an employee-owned company

SITE-SPECIFIC UFP QUALITY ASSURANCE PROJECT PLAN, REVISION 1

NIAGARA FALLS BOULEVARD RADIOLOGICAL SITE NIAGARA FALLS, NIAGARA COUNTY, NEW YORK

Prepared By:

Removal Support Team 3
Weston Solutions, Inc.
Engineering, Science, and Technology Division
Edison, New Jersey 08837

DC No.: RST3-03-D-0259
TDD No.: TO-0007-0011
EPA Contract No.: EP-S2-14-01

May 2017

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LIST OF ACRONYMS

ADR Automated Data Review
ANSETS Analytical Services Tracking System
AOC Acknowledgment of Completion
ASTM American Society for Testing and Materials
CEO Chief Executive Officer
CERCLA Comprehensive Environmental Response, Compensation and Liability Act
CLP Contract Laboratory Program
CFM Contract Financial Manager
CO Contract Officer
COI Conflict of Interest
COO Chief Operations Officer
CRDL Contract Required Detection Limit
CRTL Core Response Team Leader
CRQL Contract Required Quantitation Limit
CQLOSS Corporate Quality Leadership and Operations Support Services
CWA Clean Water Act
DCN Document Control Number
DESA Division of Environmental Science and Assessment
DI Deionized Water
DPO Deputy Project Officer
DQI Data Quality Indicator
DQO Data Quality Objective
EM Equipment Manager
EDD Electronic Data deliverable
ENVL Environmental Unit Leader
EPA Environmental Protection Agency
ERT Environmental Response Team
FASTAC Field and Analytical Services Teaming Advisory Committee
GC/ECD Gas Chromatography/Electron Capture Detector
GC/MS Gas Chromatography/Mass Spectrometry
HASP Health and Safety Plan
HRS Hazard Ranking System
HSO Health and Safety Officer
ITM Information Technology Manager
LEL Lower Explosive Limit
MSA Mine Safety Appliances
MS/MSD Matrix Spike/Matrix Spike Duplicate
NELAC National Environmental Laboratory Accreditation Conference
NELAP National Environmental Laboratory Accreditation Program
NIOSH National Institute for Occupational Safety and Health
NIST National Institute of Standards and Technology
OSC On-Scene Coordinator
OSHA Occupational Safety and Health Administration

LIST OF ACRONYMS (Concluded)

OSWER Office of Solid Waste and Emergency Response
PARCCS Precision, Accuracy, Representativeness, Completeness, Comparability, Sensitivity
PAH Polynuclear Aromatic Hydrocarbons
PCB Polychlorinated Biphenyls
PIO Public Information Officer
PM Program Manager
PO Project Officer
PRP Potentially Responsible Party
PT Proficiency Testing
QA Quality Assurance
QAL Quality Assurance Leader
QAPP Quality Assurance Project Plan
QMP Quality Management Plan
QA/QC Quality Assurance/Quality Control
QC Quality Control
RC Readiness Coordinator
RCRA Resource Conservation and Recovery Act
RPD Relative Percent Difference
RSCC Regional Sample Control Coordinator
RST Removal Support Team
SARA Superfund Amendments and Reauthorization Act
SEDD Staged Electronic Data Deliverable
SERAS Scientific, Engineering, Response and Analytical Services
SOP Standard Operating Practice
SOW Statement of Work
SPM Site Project Manager
START Superfund Technical Assessment and Response Team
STR Sampling Trip Report
TAL Target Analyte List
TCL Total Compound List
TDD Technical Direction Document
TDL Technical Direction Letter
TO Task Order
TQM Total Quality Management
TSCA Toxic Substances Control Act
UFP Uniform Federal Policy
VOA Volatile Organic Analysis

CROSSWALK

The following table provides a "cross-walk" between the QAPP elements outlined in the Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAP P Manual), the necessary information, and the location of the information within the text documen t and corresponding QAPP Worksheet. Any QAPP elements and required information that are not applicable to the project are circled.

QAPP Element(s) and Corresponding Section(s) of UFP-QAPP Manual	Required Information	Crosswalk to QAPP Section	Crosswalk to QAPP Worksheet No.
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2.4 Project Organization 2.4.1 Project Organizational Chart 2.4.2 Communication Pathways 2.4.3 Personnel Responsibilities and Qualifications 2.4.4 Special Training Requirements and Certification	- Project Organizational Chart - Communication Pathways - Personnel Responsibilities and Qualifications - Special Personnel Training Requirements	2	5 6 7 8
2.5 Project Planning/Problem Definition 2.5.1 Project Planning (Scoping) 2.5.2 Problem Definition, Site History, and Background	- Project Planning Session Documentation (including Data Needs tables) - Project Scoping Session Participants Sheet - Problem Definition, Site History, and Background - Site Maps (historical and present)	1	 9 10
2.6 Project Quality Objectives and Measurement Performance Criteria 2.6.1 Development of Project Quality Objectives Using the Systematic Planning Process 2.6.2 Measurement Performance Criteria	- Site-Specific PQOs - Measurement Performance Criteria	3	11 12
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QAPP Element(s) and Corresponding Section(s) of UFP-QAPP Manual	Required Information	Crosswalk to QAPP Section	Crosswalk to QAPP Worksheet No.
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3.2 Analytical Tasks 3.2.1 Analytical SOPs 3.2.2 Analytical Instrument Calibration Procedures 3.2.3 Analytical Instrument and Equipment Maintenance, Testing, and Inspection Procedures 3.2.4 Analytical Supply Inspection and Acceptance Procedures	- Analytical SOPs - Analytical SOP References - Analytical Instrument Calibration - Analytical Instrument and Equipment Maintenance, Testing, and Inspection	6	23 24 25
3.3 Sample Collection Documentation, Handling, Tracking, and Custody Procedures 3.3.1 Sample Collection Documentation 3.3.2 Sample Handling and Tracking System 3.3.3 Sample Custody	- Sample Collection Documentation Handling, Tracking, and Custody SOPs - Sample Container Identification - Sample Handling Flow Diagram - Example Chain-of-Custody Form and Seal	7	26 27
3.4 Quality Control Samples 3.4.1 Sampling Quality Control Samples 3.4.2 Analytical Quality Control Samples	- QC Samples - Screening/Confirmatory Analysis Decision Tree	5	28

QAPP Element(s) and Corresponding Section(s) of UFP-QAPP Manual	Required Information	Crosswalk to QAPP Section	Crosswalk to QAPP Worksheet No.
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QAPP Worksheet #1: Title and Approval Page

Title: Site-Specific UFP Quality Assurance Project Plan, Revision 1
Site Name/Project Name: Niagara Falls Boulevard Radiological Site
Site Location: Niagara Falls, Niagara County, New York
Revision Number: 01
Revision Date: May 5, 2017

Weston Solutions, Inc.
Lead Organization

Bernard Nwosu
Weston Solutions, Inc.
1090 King Georges Post Road, Suite 201
Edison, NJ 08837
Email: ben.nwosu@westonsolutions.com

Preparer's Name and Organizational Affiliation

5 May 2017
Preparation Date (Day/Month/Year)

Site Project Manager:

Signature

Patrick Buster/Weston Solutions, Inc.
Printed Name/Organization/Date

QA Officer/Technical Reviewer: Smita Sumbaly

Signature

Smita Sumbaly/Weston Solution, Inc.
Printed Name/Organization/Date

EPA, Region II On-Scene Coordinator (OSC):

Signature

Eric Daly/EPA, Region II
Printed Name/Organization/Date

EPA, Region II Quality Assurance Officer (QAO):

Signature

Printed Name/Organization/Date

QAPP Worksheet #2
QAPP Identifying Information

Site Name/Project Name: Niagara Falls Boulevard Radiological Site
Site Location: Niagara Falls, Niagara County, New York
Operable Unit: 00
Title: Site-Specific UFP Quality Assurance Project Plan, Revision 1
Revision Number: 01
Revision Date: May 5, 2017

1. Identify guidance used to prepare QAPP:
Uniform Federal Policy for Quality Assurance Project Plans. Refer to EPA Methods and Laboratory SOPs.

2. Identify regulatory program: EPA, Region II

3. Identify approval entity: EPA, Region II

4. Indicate whether the QAPP is a generic or a site -specific QAPP.

5. List dates of scoping sessions that were held:4/12/2017, 4/18/2017

6. List dates and titles of QAPP documents written for previous site work, if applicable:

Site-Specific UFP Quality Assurance Project Plan, August 6, 2015, DCN#: RST3-02-D-0033

Site-Specific UFP Quality Assurance Project Plan, February 25, 2016, DCN#: RST3-02-D-0208

7. List organizational partners (stakeholders) and connection with lead organization:

None

8. List data users: EPA, Region II (see Worksheet #4 for individuals)

9. If any required QAPP elements and required information are not applicable to the project, then provide an explanation for their exclusion below: The following Worksheets #s: 12, 15, 23, 24, 25, 28, and 30 will be updated after RST 3 completes the Analytical Request Form for soil sampling and receives EPA approval.

10. Document Control Number: RST3-03-D-0259

QAPP Worksheet #3: Distribution List

[List those entities to which copies of the approved site-specific QAPP, subsequent QAPP revisions, addenda, and amendments are sent]

QAPP Recipient	Title	Organization	Telephone Number	Fax Number	E-mail Address	Document Control Number
Eric Daly	On-Scene Coordinator	EPA, Region II	(732) 321-4350	(732) 321-4350	Daly.Eric@epa.epamail.gov	RST3-03-D-0259
Patrick Buster	Site Project Manager	Weston Solutions, Inc., RST 3	(732) 321-4411	(732) 225-7037	Patrick.Buster@WestonSolutions.com	RST3-03-D-0259
Smita Sumbaly	QA Officer	Weston Solutions, Inc., RST 3	(732) 585-4410	(732) 225-7037	S.Sumbaly@westonsolutions.com	RST3-03-D-0259
Site TDD File	RST 3 Site TDD File	Weston Solutions, Inc., RST 3	Not Applicable	Not Applicable	Not Applicable	RST3-03-D-0259

QAPP Worksheet #4: Project Personnel Sign-Off Sheet

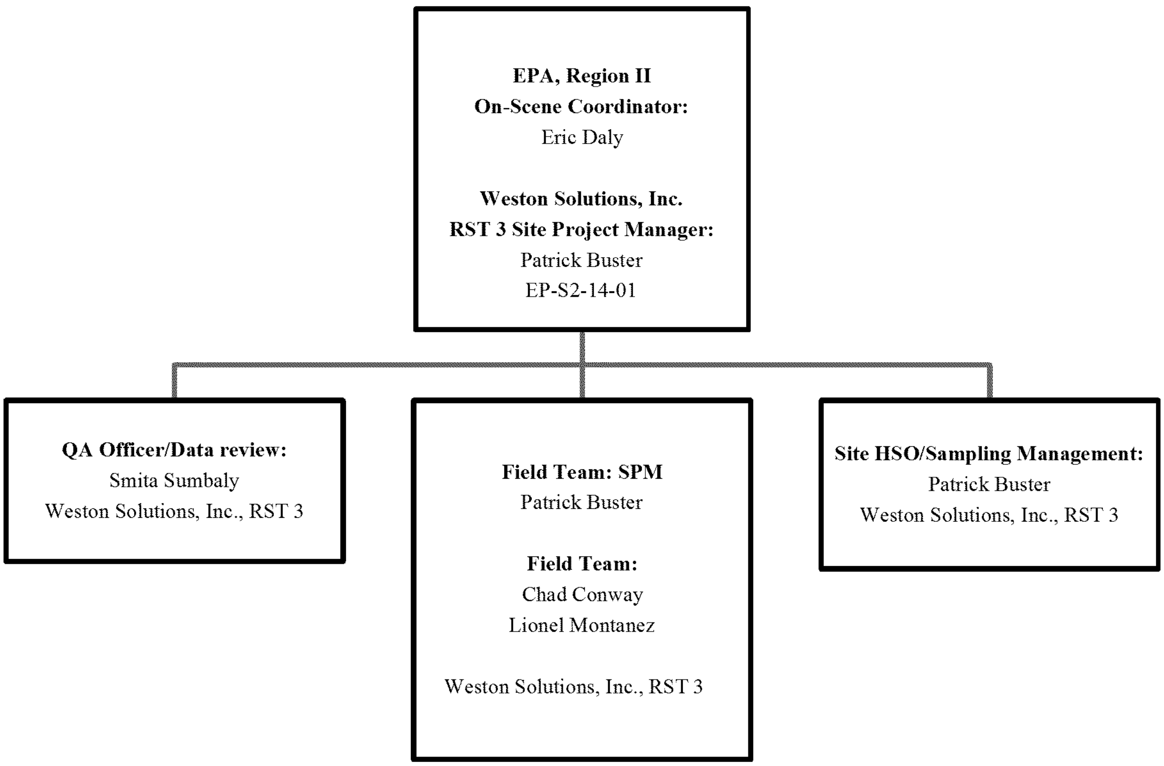
[Copies of this form signed by key project personnel from each organization to indicate that they have read the applicable sections of the site-specific QAPP and will perform the tasks as described; add additional sheets as required. Ask each organization to forward signed sheets to the central project file.]

Organization: Weston Solutions, Inc., RST 3

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read
Eric Daly	EPA OSC	(732) 321-4350		
Patrick Buster	Site Project Manager, RST 3	(732) 321-4411	[signature]	5/5/17
Smita Sumbaly	QAO, RST 3	(732) 585-4410	Smita Sumbaly	5/5/17
Timothy Benton	Operations Leader / HSO, RST 3	(732) 585-4425	[signature]	5/5/17
Chad Conway	Field Personnel, RST 3	(832) 347-3430		
Lionel Montanez	Field Personnel, RST 3	(732) 585-4436		

QAPP Worksheet #5: Project Organizational Chart

Identify reporting relationship between all organizations involved in the project, including the lead organization and all contractor and subcontractor organizations. Identify the organizations providing field sampling, on-site and off-site analysis, and data review services, including the names and telephone numbers of all project managers, project team members, and/or project contacts for each organization.



Acronyms:

SPM: Site Project Manager
HSO: Health & Safety Officer

QAPP Worksheet #6: Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure
Point of contact with EPA OSC	Site Project Manager, Weston Solutions, Inc., RST 3	Patrick Buster SPM	(732) 321-4411	All technical, QA and decision-making matters in regard to the project (verbal, written or electronic)
Adjustments to QAPP	Site Project Manager, Weston Solutions, Inc., RST 3	Patrick Buster SPM	(732) 321-4411	QAPP approval dialogue
Health and Safety On-Site Meeting	HSO, Weston Solutions, Inc., RST 3	Patrick Buster SPM	(732) 321-4411	Explain Site hazards, personnel protective equipment, hospital location, etc.

OSC: On-Scene Coordinator
SPM: Site Project Manager
HSO: Health and Safety Officer

QAPP Worksheet #7: Personnel Responsibilities and Qualifications Table

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Eric Daly	EPA On-Scene Coordinator	EPA, Region II	All project coordination, direction and decision making.	NA
Patrick Buster	Field Personnel, RST 3	Weston Solutions, Inc.	Site Project Manager/HSO/EPA point of contact	10+ Years
Chad Conway	Field Personnel, RST 3	Weston Solutions, Inc.	Sample collection	10+ Years
Lionel Montanez	Field Personnel, RST 3	Weston Solutions, Inc.	Sample collection	10+ Years

*All RST 3 members, including subcontractor's resumes are in possession of RST 3 Program Manager, EPA Project Officer, and Contracting officers.

QAPP Worksheet #8: Special Personnel Training Requirements Table

Project Function	Specialized Training By Title or Description of Course	Training Provider	Training Date	Personnel / Groups Receiving Training	Personnel Titles / Organizational Affiliation	Location of Training Records / Certificates[1]
[Specify location of training records and certificates for samplers]						
QAPP Training	This training is presented to all RST 3 personnel to introduce the provisions, requirements, and responsibilities detailed in the UFP QAPP. The training presents the relationship between the site-specific QA Project Plans (QAPPs), SOPs, work plans, and the Generic QAPP. QAPP refresher training will be presented to all employees following a major QAPP revision.	Weston Solutions, Inc., QAO	As needed	All RST 3 field personnel upon initial employment and as refresher training	Weston Solutions, Inc.	Weston Solutions, Inc., EHS Database
Health and Safety Training	Health and safety training will be provided to ensure compliance with Occupational Safety and Health Administration (OSHA) as established in 29 CFR 1910.120.	Weston Solutions, Inc., HSO	Yearly at a minimum	All Employees upon initial employment and as refresher training every year	Weston Solutions, Inc.	Weston Solutions, Inc., EHS Database
Others	Scribe, ICS 100 and 200, and Air Monitoring Equipment Trainings provided to all employees	Weston Solutions, Inc., QAO/Group Leader's	Upon initial employment and as needed			
	Dangerous Goods Shipping	Weston Solutions, Inc., HSO	Every 2 years			

All team members are trained in the concepts and procedures in recognizing opportunities for continual improvement, and the approaches required to improve procedures while maintaining conformance with legal, technical, and contractual obligations.

[1] All RST 3 members, including subcontractor's certifications are in possession of RST 3 HSO.

QAPP Worksheet #9: Project Scoping Session Participants Sheet

Site Name/Project Name: Niagara Falls Boulevard Radiological Site
Site Location: Niagara Falls, Niagara County, New York
Operable Unit: 00
Date of Sessions: 4/12/2017, 4/18/2017
Scoping Session Purpose: To discuss questions, comments, and assumptions regarding technical issues involved with the sampling activities.

Name	Title	Affiliation	Phone #	E-mail Address	*Project Role
Eric Daly	EPA OSC	EPA, Region II	(732) 321-4350	Daly.Eric@epa.gov	OSC
Lyndsey Nguyen	EPA Health Physicist	EPA ERT	(702) 373-3756	nguyen.lyndsey@epa.gov	Health Physicist
Bernard Nwosu	*For:* Site Project Manager	Weston Solutions, Inc., RST 3	(732) 585-4413	Ben.Nwosu@WestonSolutions.com	Site Project Management/QA Officer/ Technical Reviewer
Chad Conway	Field Personnel	Weston Solutions, Inc., RST 3	(832) 347-3430	r.conway@westonsolutions.com	Field Personnel
Timothy Benton	HSO	Weston Solutions, Inc., RST 3	(732) 585-4425	tim.benton@ westonsolutions.com	Health and Safety

Comments/Decisions: As part of the Removal Assessment of the Niagara Falls Boulevard Radiological Site (the Site), Weston Solutions, Inc., Removal Support Team 3 (RST 3) has been tasked by the U.S. Environmental Protection Agency (EPA) with procuring the services of a subcontractor to advance test pits at locations throughout the Site for soil/slag/rock sampling. Prior to mobilizing to the Site, RST 3 subcontractor will contact Dig Safely New York to conduct a subsurface utility mark out of the existing underground public utilities. In addition, RST 3 subcontractor will perform a private utility mark out to locate any underground utilities at selected sampling locations before advancing any test pit. Based on results from prior radiological survey performed at the Site, test pit locations will be preselected by the EPA On-Scene Coordinator (OSC) and marked out on-site with spray paint at location with asphalt surfaces or flagged at locations in soil. Prior to advancing test pits located on asphalt surfaces, the asphalt will be saw-cut by RST 3 subcontractor in a 4 foot by 4 foot area and removed to expose the soil. Utilizing a mini excavator, RST 3 subcontractor will advance up to 20 test pits to a depth of 4 feet below ground surface (bgs) at selected test pit locations in on-site areas of concern (AOCs), including Area 1 through Area 5, Area 7, and a background area of the Site.

Upon completing each test pit, RST 3 will document the soil characteristics, description, and depths of visible slag/rock material within each test pit in order to provide reference information for estimating volumes of waste to be potentially removed from the area. Up to 168 heterogeneous samples of soil/slag/rock, including eight field duplicates, will be collected from all the test pits throughout the Site. The samples will be collected from the side walls of each test pit at every 6 inch interval up to 48 inches bgs, and to reduce chances of cross contamination between sampling intervals, the samples will be collected in

QAPP Worksheet #9: Project Scoping Session Participants Sheet (concluded)

Comments/Decisions (Concluded):

reverse order using dedicated disposable scoops starting from the deepest interval upwards to the surface. Fresh nitrile gloves will be donned between each sampling interval and location. Prior to sample collection at each interval, the bottom of the scoop will be used to scrape each area of the sidewall to be sampled in order to expose fresh soil/slag/rocks which will be collected, placed directly into dedicated re-sealable plastic bags, and homogenized. The sample identification information, date and time of sample collection will be recorded on the outside of each dedicated re-sealable plastic bag. Field duplicates and additional sample volumes for matrix spike/matrix spike duplicate (MS/MSD) analysis will be collected at a frequency of one per 20 field samples.

Once all samples have been collected within each test pit, RST 3 subcontractor will relocate the investigation-derived waste (IDW) to Area 7 where it will be staged on and securely covered with polyethylene sheeting. For safety, RST 3 subcontractors will backfill each test pit as soon as possible with fill material provided on-site in the form of pre-analyzed soil stockpile. All the backfilled test pit locations on asphalt surfaces will be restored by RST 3 subcontractor as close as possible to pre-existing conditions with asphalt over a gravel base.

The soil/slag/rock samples will be transferred into 16 ounce (oz.) polyethylene (poly) containers and analyzed on site utilizing a High-purity Germanium (HPGe) detector. Based on the results generated by the HPGe detector, EPA will determine the samples to be shipped offsite for laboratory analysis. The samples will be collected for definitive data and quality assurance/quality control (QA/QC) purposes, and will be analyzed in the laboratory for bismuth-212 (Bi-212), cesium-137 (Cs-137), potassium-40 (K-40), lead-212 (Pb-212), protactinium-234 (Pa-234), radium-226 (Ra-226), radium-228 (Ra-228), thorium-228 (Th-228), thorium-230 (Th-230), thorium-232 (Th-232), thorium-234 (Th-234), thallium-208 (Tl-208), uranium-233/234 (U-233/234), uranium-235/236 (U235/236), uranium-235 (U235), and uranium-238 (U238).

Removal Assessment activities are subject to change at the discretion of the EPA OSC while site operations are being conducted due to unforeseen circumstances, unfavorable weather conditions, or an improved sample methodology is identified.

Consensus Decisions: The soil sampling event is scheduled to begin on May 8, 2017.

Action Items: RST 3 needs to procure the services of a subcontractor to advance test pits on-site.

QAPP Worksheet #10: Problem Definition

PROBLEM DEFINITION

Historical information indicates that slag deposits from unknown source was deposited on the Site. Prior site investigations, including radiological surveys and soil sampling events, identified locations with elevated levels of gamma radiation and the presence of radionuclides in soil throughout the Site. EPA is conducting a Removal Assessment to verify the presence of radiation-containing material at locations throughout the Site in order to delineate the extent of the contamination. The information that will be generated from this event will enable EPA to determine the volume of contaminated soil that will be excavated from the various AOCs designated for the ongoing Removal Action being conducted to address the presence of radiation-containing material on the Site.

SITE HISTORY/CONDITIONS

The Site is located in a mixed commercial and residential area of Niagara Falls, New York. The Site consists of two parcels, namely 9524 and 9540 Niagara Falls Boulevard and it encompasses approximately 2.53 acres. Currently, the 9524 Niagara Falls Boulevard property contains a bowling alley and an asphalt parking lot; the 9540 Niagara Falls Boulevard property is occupied by a hardware store, Greater Niagara Building Center, Inc. (GNBC) and an asphalt parking lot. The properties are bordered to the north by a wooded area; to the east by a church; to the south by Niagara Falls Boulevard, beyond which is a residential area; and to the west by a hotel and residential area.

In 1978, the U.S. Department of Energy (DOE) conducted an aerial radiological survey of the Niagara Falls region and identified more than 15 properties having elevated levels of radiation above background levels. It is believed that, in the early 1960s, slag from an unknown source was used as fill on the properties prior to paving. Based on the original survey and subsequent investigations, it is believed that the radioactive slag was deposited on the Site.

In September/October 2006 and May 2007, the New York State Department of Environmental Conservation (NYSDEC) conducted radiological surveys of the interior and exterior of both properties on several occasions using gamma detectors, Exploranium-135, and Ludlum Model 2221 Ratemeter/Scaler (Ludlum-2221). With the exception of an office area and storage space at 9540 Niagara Falls Boulevard that was constructed after the original building directly on top of the asphalt parking lot, interior radiation levels obtained with Exploranium-135 were relatively low. The highest reading in the newer area was 115 microroentgen per hour (µR/hr); elsewhere throughout the building, radiation levels generally ranged between 10 and 20 µR/hr. Exterior readings taken at waist height generally ranged between 10 and 350 µR/hr, while the maximum reading of 600 µR/hr was recorded at contact (*i.e.*, at the ground surface). At a fenced area behind the building located at 9540 Niagara Falls Boulevard, waist-high readings ranged between 200 and 450 µR/hr, and contact readings ranged between 450 and 750 µR/hr. Elevated readings were also observed on the swath of grass between the 9524 Niagara Falls Boulevard property and the adjacent property to the west that contains a hotel, and in the marshy area beyond the parking lot behind the buildings. Two biased samples of slag were collected from

QAPP Worksheet #10: Problem Definition (Continued)

locations that exhibited elevated static Ludlum-2221 readings: one slag sample collected from an area of loose blacktop indicated a reading of 515,905 counts per minute (cpm) and the second slag sample collected in the marshy area indicated a reading of 728,235 cpm.

During a reconnaissance performed by the New York State Department of Health (NYSDOH) and NYSDEC on July 9, 2013, screening activities with a hand-held pressurized ion chamber (PIC) around an area of broken asphalt indicated gamma radiation levels at 200 µR/hr and 500 µR/hr from a soil pile containing slag at the Site. Readings over 600,000 cpm were recorded with a sodium iodide scintillator (NaI) from the soil and slag pile.

In September 2013, EPA's contractor, Weston Solutions, Inc., Site Assessment Team (SAT) conducted gamma radiation screening of the 9524 Niagara Falls Boulevard property using Ludlum-2221 and a NaI 2x2 detector. In December 2013, further radiological survey information was obtained from the 9524 and 9540 Niagara Falls Boulevard properties, as well as the First Assembly Church property located further east of the two site parcels at 9750 Niagara Falls Boulevard. The highest gamma screening results were recorded from the exposed soil area in the rear northern portion of the 9540 Niagara Falls Boulevard property. The areas of observed contamination were delineated by measuring the gamma radiation exposure rates and determining where the gamma radiation exposure rate around the source equals or exceeds two times (2x) the site-specific background gamma radiation exposure rates. The areas of observed contamination are defined by site-attributable gamma radiation exposure rates, as measured by a survey instrument held 1 meter above the ground surface, which equal or exceed 2x the site-specific background gamma radiation exposure rate. An area of the Site, approximately 168,832 square feet (sq. ft.), indicated gamma radiation levels exceeding 2x the background measurement of 8,391 cpm. PIC data were also collected at several points to confirm the boundary.

On December 11, 2013, SAT collected a total of 16 soil samples, including one field duplicate, and three slag samples, from fifteen boreholes advanced throughout the Site and on the First Assembly Church property, located at 9750 Niagara Falls Boulevard, directly adjacent to the east and northeast portions of the Site, using hollow-stem auger drilling methods. The two soil samples collected on the First Assembly Church property were to document background conditions. At each sample location, soil samples were collected directly beneath slag; at locations where slag was not present, the soil sample was collected at the equivalent depth interval. The soil samples were analyzed by Test America Laboratories (Test America) for target analyte list (TAL) metals; isotopic thorium and isotopic uranium, Ra-226, and Ra-228, by alpha spectroscopy; and radioisotopes by gamma spectroscopy. The slag samples were analyzed for isotopic thorium and isotopic uranium, Ra-226, and Ra-228 by alpha spectroscopy, and radioisotopes by gamma spectroscopy. Analytical results indicated concentrations of radionuclides found in the slag and soil samples to be significantly higher than at background condition.

On July 21 through 23, 2015, as part of a Removal Assessment of the Site, EPA and Weston Solutions Inc., Removal Support Team 3 (RST 3) conducted a radiological survey of on-site properties, including 9524 Niagara Falls Boulevard (Property N001), 9540 Niagara Falls

QAPP Worksheet #10: Problem Definition (Continued)

Boulevard (Property N002), and an off-site background location at 9750 Niagara Falls Boulevard (Property N003). The presence/absence of radon/thoron gases were determined using RAD7 radon/thoron detectors and gamma radiation levels were determined using Fluke Pressurized Ionization Chamber (FPIC) Model 451P, Ludlum Model 2241 (Ludlum-2241), and Reuter-Stokes RSS-131ER High Pressure Ion Chamber (HPIC) gamma survey meters. Specific isotopes were identified using a Berkeley Nucleonics Corporation (BNC) SAM 940 ™ (SAM-940) portable radioisotope identification system. Radiological survey measurements collected from suspected source areas at Properties N001 and N002 were compared with measurements collected from a background location at property N003. The background readings collected with each survey instrument were as follows (instrument and measured reading in parenthesis): Ludlum-2241 (7,000 to 8,000 cpm), FPIC (waist-high: 7 to 10 μR/hr, contact: 9 to 10 μR/hr), HPIC (8.24 μR/hr), and RAD7 (less than 4 pCi/L).

Gamma measurements collected with the Ludlum-2241 in the single building at Property N001 indicated readings ranging from 6,400 cpm around the pin setter area to 45,000 cpm (more than 5x the upper limit background value) in the rear vestibule. Gamma readings in most areas of the building at Property N001 were generally above background values. Gamma readings collected with the Ludlum-2241 in the single building at Property N002 ranged from 6,200 cpm in the showroom to 200,000 cpm (more than 23x the upper limit background value) in one storage room located southwest of the building. Generally, gamma readings in most areas of the building at Property N002 varied from background to several times above the background upper limit value. Gamma survey conducted with the Ludlum-2241 in exterior areas throughout the Site, including asphalt-paved and unpaved areas of both Properties N001 and N002, indicated gamma readings ranging from 10,500 cpm (at a location on the southwest side of Property N001 near the adjacent hotel parking lot) to 600,000 cpm (more than 70x the background upper limit value) at a fenced area located behind Property N002. Gamma readings collected in exterior areas of the Site were generally more than 2x the background value.

The HPIC gamma measurement collected in the rear vestibule of Property N001 was 18.48 μR/hr, which was more than 2x the background reading collected with this instrument. The HPIC gamma measurements collected in the single building at Property N002 were more than 4x the background value at four hotspots, including a location in one storage room southwest of the building, a location near the southern access to the middle warehouse space, a location in a storage space northwest of the building, and a drainage trench at the furthest north warehouse space.

The highest FPIC gamma measurements collected at Property N001 was from a walk-in cooler, with waist-high measurements ranging from 8 to 13 μR/hr and contact measurements ranging from 14 to 19 μR/hr. These measurements were above the background readings collected with this instrument. At Property N002, FPIC gamma measurements were more than 2x the background value in the entire area of the warehouse space located furthest north, portions north and center of the middle warehouse space, areas in three storage rooms northwest and west, respectively, of the building, and areas in an office space and storage room located southwest of the building. The four hotspots identified in the building at Property N002 had waist-high measurements ranging from 24 to 100 μR/hr and contact measurements ranging from 36 to 160

QAPP Worksheet #10: Problem Definition (Continued)

μR/hr. One radionuclide, Th-232, was identified with the SAM-940 in the drainage trench located in the furthest north warehouse space at Property N002. Radon/thoron survey results indicated normal radon levels in both on-site buildings.

On August 10 through 13, 2015, RST 3 conducted additional Removal Assessment of the Site. Soil sampling and radiological survey of exterior on-site locations was performed in order to verify potential releases of radiation-containing materials in soil and fill material associated with slag from the former Union Carbide facility, determine radiation source areas, and delineate the extent of on-site radiological contamination. Soil sampling locations were selected based on information from prior SAT site investigation and from radiological survey measurements collected as part of the Phase I Removal Assessment. Gamma measurements collected with the HPIC at all the soil sampling locations ranged from 9.92 μR/hr to 267.44 μR/hr (more than 32x the background value). Radon/thoron survey results indicated normal radon levels at all the soil sampling locations. Thoron concentrations were above background levels and the EPA Site-Specific Action Level of 4 pCi/L in contact measurements taken from six of the seven soil sampling locations and one waist-high measurement at Property N001. Thoron concentrations were also above background levels and the EPA Site-Specific Action Level in contact measurements taken from five of the eight soil sampling locations at Property N002. Waist-high thoron measurements taken at all the soil sampling locations at Property N002 were within normal background levels.

During the August 2015 soil sampling event, a total of 18 soil samples were collected by RST 3 using Geoprobe® technology from locations throughout the Site. Each soil core was screened every 6-inch interval for gamma radiation using Ludlum-2241. Soil samples were selected from the 6-inch interval which exhibited the highest level of gamma radiation and/or where a fill layer was observed and/or at the discretion of the EPA On-Scene Coordinator (OSC). The soil samples were analyzed by Test America of St. Louis, Missouri for TAL metals in accordance with EPA SW846 Method 6010C; total mercury, in accordance with EPA SW846 Method 7471B; isotopic thorium (thorium-228 (Th-228), Th-230, Th-232, and Th-234) and isotopic uranium (uranium-233 (U-233), U-234, U-235, U-236, and U-238), in accordance with DOE alpha spectroscopy Health and Safety Laboratory (HASL)-300 Method A-01-R; Ra-226 (21-day ingrowth), Ra-228, and other gamma emitting radioisotopes, in accordance with EPA gamma spectroscopy HASL-300 Method GA-01-R. Aqueous rinsate blanks collected to demonstrate proper decontamination of non-dedicated sampling equipment were analyzed for TAL metals, total mercury, isotopic thorium and isotopic uranium, and other gamma emitting radioisotopes by the same methods as the soil samples. Aqueous rinsate blanks were also analyzed for Ra-226 in accordance with EPA SW-846 Method 9315 and Ra-228 by Gas Flow Proportional Counter (GFPC), in accordance with EPA SW-846 Method 9320. Analytical results indicated that the concentrations of Ra-226 in on-site soils were above the EPA Site-Specific Action Level of 2.48 picocuries per gram (pCi/g). Analytical results also indicated exceedance of manganese, magnesium, iron, and thallium above the EPA Removal Management Levels (RMLs) in at least one or more soil samples.

QAPP Worksheet #10: Problem Definition (Continued)

PROJECT DESCRIPTION

RST 3 has been tasked by EPA with procuring the services of a subcontractor to advance test pits at locations throughout the Site for soil/slag/rock sampling. Based on results from prior radiological surveys performed at the Site, test pit locations will be preselected by the EPA OSC and marked out on-site. Prior to advancing test pits located on asphalt surfaces, the asphalt will be saw-cut by RST 3 subcontractor in a 4 foot by 4 foot area and removed to expose the soil. Utilizing a mini excavator, RST 3 subcontractor will advance up to 20 test pits to a depth of 4 feet bgs at all the selected test pit locations in Area 1 through Area 5, Area 7, and a background area of the Site. Upon completing each test pit, RST 3 will document the soil characteristics, description, and depths of visible slag/rock material within each test pit in order to provide reference information for estimating volumes of waste to be potentially removed from the area. Heterogeneous samples of soil/slag/rock will be collected from the side walls of each test pit at every 6 inch interval up to 48 inches bgs. The soil/slag/rock samples will be transferred into 16 oz. poly containers and analyzed on site utilizing HPGe detector. Based on the results generated by the HPGe detector, EPA will determine the samples to be shipped offsite for laboratory analysis.

OBSERVATION FROM ANY SITE RECONNAISSANCE REPORT

The highest gamma screening results recorded by SAT in September 2013 with Ludlum-2221 and NaI scintillator was from the exposed soil area in the rear northern portion of the 9540 Niagara Falls Boulevard property and an area of the Site approximately 168,832 ft^2 was documented with gamma radiation levels exceeding 2x background. Analytical results of soil samples collected in December 2013 by SAT indicated concentrations of radionuclides found in the slag and soil samples to be significantly higher than at background condition. Gamma readings documented in July 2015 by RST 3 in the on-site building at the 9540 Niagara Falls Boulevard property ranged from 6,200 cpm to 200,000 cpm. Gamma survey conducted by RST 3 in exterior areas throughout the Site, including asphalt-paved and unpaved areas ranged from 10,500 cpm to 600,000 cpm. Analytical results of soil samples collected by RST 3 in August 2015 indicated concentrations of Ra-226 above the EPA SSAL of 2.48 pCi/g. Gamma measurements collected by RST 3 in August 2015 with the HPIC at soil sampling locations ranged from 9.92 µR/hr to 267.44 µR/hr and analytical results of the soil samples collected during the event indicated concentrations of Ra-226 above the EPA SSAL of 2.48 pCi/g. Analytical results of soil samples collected by RST 3 in March 2016 inside the single building on the 9540 Niagara Falls Boulevard property indicated that concentrations of Ra-226 and Ra-228 were above the respective EPA SSAL. Radiological survey conducted by RST 3 in June 2016 showed elevated gamma levels in Area 1 and Area 7, portions of Area 2, Area 3, Area 5, Area 6, and Area 8. Analytical results of soil/slag/rock samples collected by RST 3 from Area 1 and Area 7 in October 2016 indicated that concentrations of target radionuclides, including Ra-226 and Ra-228 were above the respective EPA SSALs.

QAPP Worksheet #10: Problem Definition (Concluded)

PROJECT DECISION STATEMENTS

The purpose of the sampling event is to determine the vertical and horizontal extent of radiation-containing material in the form of soil/slag/rocks that may exist in the subsurface soils located throughout of the Site. The information that will be generated from this event will enable EPA to determine the volume of contaminated soil that will be excavated from the various AOCs designated for the ongoing Removal Action being conducted to address the presence of radiation-containing material on the Site.

QAPP Worksheet # 11: Project Quality Objectives/Systematic Planning Process Statement

Overall project objectives include: To determine the vertical and horizontal extent of radiation-containing material in the form of soil/slag/rocks that may exist in the subsurface soils located throughout of the Site.

Who will use the data? Data will be used by EPA, Region II OSC.

What will the data be used for? The analytical data from this investigation will be used to assist EPA in determining the volume of contaminated soil that will be excavated from the various AOCs designated for the ongoing Removal Action.

What types of data are needed?
Type of Data: Definitive data for soil samples

Analytical Techniques: Onsite quantitative analysis using HPGe/off-site laboratory analyses for soil samples.

Parameters: For soil/slag/rock samples, Bi-212, Cs-137, K-40, Pb-212, Pa-234, Ra-226, Ra-228, Th-228, Th-230, Th-232, Th-234, Tl-208, U-233/234, U235/236, U235, and U238.

Type of survey/sampling equipment: Ludlum-2241 with NaI scintillator for survey and excavator, scoops, re-sealable plastic bags, and 16 oz. poly sample jars.

Access Agreement: To be provided by EPA, Region II OSC.

Sampling locations: Soil sampling locations will be determined based on results from prior radiological surveys and soil sampling events at locations where elevated levels of gamma radiation and radionuclide concentrations were observed.

How much data are needed? Up to 168 soil/slag/rock samples, including eight field duplicates will be collected from locations throughout the Site. No rinsate will be collected.

How "good" does the data need to be in order to support the environmental decision? Sampling/analytical measurement performance criteria for Precision, Accuracy, Representativeness, Completeness, and Comparability (PARCC) parameters will be established. Refer to Worksheet #12, criteria for performance measurement for definitive data.

Where, when, and how should the data be collected/generated? Soil/slag/rock samples will be collected from 20 test pit locations in Area 1 through Area 5, Area 7, and a background area of the Site. The sampling event will begin on May 8, 2017. Sampling will be conducted in accordance with EPA's Environmental Response Team (ERT)/Scientific, Engineering, Response and Analytical Services (SERAS) contractor's Standard Operating Procedure (SOP) Number (No.) 2001: *General Field Sampling Guidelines* and SOP No. 2012: *Soil Sampling*. Soil samples will be collected for definitive data and QA/QC objectives.

QAPP Worksheet # 11:
Project Quality Objectives/Systematic Planning Process Statement (Concluded)

Who will collect and generate the data? The soil/slag/rock samples will be collected by RST 3 personnel, analyzed onsite with HPGe detector for quantitative data and offsite at a laboratory (to be determined) for qualitative data. Soil/slag/rock analytical data will be subcontracted for data validation.

How will the data be reported? All data will be reported by the assigned laboratory (Preliminary, Electronic, and Hard Copy format). The Site Project Manager will provide a Sampling Trip Report, Status Reports, Maps/Figures, Analytical Report, and Data Validation Report to the EPA OSC.

How will the data be archived? Electronic data deliverables will be archived in a Scribe database. Non-CLP data will be archived in EPA's document control room.

QAPP Worksheet #13: Secondary Data Criteria and Limitations Table

Any data needed for project implementation or decision making that are obtained from non-direct measurement sources such as computer databases, background information, technologies and methods, environmental indicator data, publications, photographs, topographical maps, literature files and historical data bases will be compared to the DQOs for the project to determine the acceptability of the data. Thus, for example, analytical data from historical surveys will be evaluated to determine whether they satisfy the validation criteria for the project and to determine whether sufficient data was provided to allow an appropriate validation to be done. If not, then a decision to conduct additional sampling for the site may be necessary.

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Types, Data Generation/ Collection Dates)	How Data May Be Used (if deemed usable during data assessment stage)	Limitations on Data Use
EPA Investigation	Site Inspection Report. DCN#: 2223-2A-BKYP	Weston Solutions, Inc. (SAT Region 2)	To determine possible areas of observed contamination.	Screening-level data
EPA Removal Assessments, July & August 2015	RST 3 Removal Assessment Trip Report, DCN#: RST3-02-D-0145	Weston Solutions, Inc. (RST 3 Region 2)	To verify the presence of residual radiological contamination in on-site buildings, potential releases of radiation-containing materials in soil and fill material, determine radiation source areas, and delineate the extent of on-site radiological contamination	Definitive data
EPA Removal Assessments, March 2016	RST 3 Phase II Removal Assessment Trip Report, DCN#: RST3-03-D-0085	Weston Solutions, Inc. (RST 3 Region 2)	To verify the presence of radiation-containing material in subsurface soil and to define the vertical and horizontal extent of the contamination inside the the single building on the 9540 Niagara Falls Blvd property.	Definitive data

QAPP Worksheet #14: Summary of Project Tasks

Sampling Tasks:

RST 3 has been tasked by EPA with providing a subcontractor to utilize a mini excavator to advance up to 20 test pits to a depth of 4 bgs at selected test pit locations in on-site AOCs, including Area 1 through Area 5, Area 7, and a background area of the Site. Upon completing each test pit, RST 3 will document the soil characteristics, description, and depths of visible slag/rock material within each test pit. RST 3 will collect up to 168 heterogeneous soil/slag/rock samples, including eight field duplicates, from the side walls of each test pit at 6 inch intervals from 0-6, 6-12, 12-18, 18-24, 24-30, 30-36, 36-42, and 42-48 inches bgs. Using dedicated disposable scoops, the samples will be collected in reverse order starting from the deepest interval upwards to the surface. The samples will be placed directly into dedicated re-sealable plastic bags, homogenized, and then transferred into 16 oz. poly containers. Field duplicates and additional sample volumes for matrix spike/matrix spike duplicate (MS/MSD) analysis will be collected at a frequency of one per 20 field samples. The soil/slag/rock sampling will begin on May 8, 2017.

Analysis Tasks:

The soil/slag/rock samples will be analyzed on-site for quantitative data by RST 3 personnel using a HPGe before being shipped offsite for laboratory analysis. Laboratory analytical methods will be updated upon approval of RST 3 Analytical Request Form by EPA.

Data Management Tasks:

Activities under this project will be reported in status and trip reports and other deliverables (e.g., analytical reports, final reports) described herein. Activities will also be summarized in appropriate format for inclusion in monthly and annual reports.

The following deliverables will be provided under this project:

Trip Report: A trip report will be prepared to provide a detailed accounting of what occurred during each sampling mobilization. The trip report will be prepared within two weeks of the last day of each sampling mobilization. Information will be provided on time of major events, dates, and personnel on-site (including affiliations).

Maps/Figures: Maps depicting site layout, contaminant source areas, and sample locations will be included in the trip report, as appropriate.

Analytical Report: An analytical report will be prepared for samples analyzed under this plan. Information regarding the analytical methods or procedures employed, sample results, QA/QC results, chain-of-custody documentation, laboratory correspondence, and raw data will be provided within this deliverable.

Data Review: A review of the data generated under this plan will be undertaken. The assessment of data acceptability or usability will be provided separately, or as part of the analytical report.

QAPP Worksheet #14: Summary of Project Tasks (Continued)

<u>Documentation and Records:</u>

All sample documents will be completed legibly, in ink. Any corrections or revisions will be made by lining through the incorrect entry and by initialing the error.

<u>Field Logbook:</u> The field logbook is essentially a descriptive notebook detailing site activities and observations so that an accurate account of field procedures can be reconstructed in the writer's absence. Field logbook will be bound and paginated. All entries will be dated and signed by the individuals making the entries, and should include (at a minimum) the following

1. Site name and project number
2. Name(s) of personnel on-site
3. Dates and times of all entries (military time preferred)
4. Descriptions of all site activities, site entry and exit times
5. Noteworthy events and discussions
6. Weather conditions
7. Site observations
8. Sample and sample location identification and description*
9. Subcontractor information and names of on-site personnel
10. Date and time of sample collections, along with chain of custody information
11. Record of photographs
12. Site sketches

* The description of the sample location will be noted in such a manner as to allow the reader to reproduce the location in the field at a later date.

<u>Sample Labels:</u> Sample labels will clearly identify the particular sample, and should include the following:

1. Site/project number.
2. Sample identification number.
3. Sample collection date and time.
4. Designation of sample (grab or composite).
5. Sample preservation.
6. Analytical parameters.
7. Name of sampler.

Sample labels will be written in indelible ink and securely affixed to the sample container. Tie-on labels can be used if properly secured.

<u>Custody Seals:</u> Custody seals demonstrate that a sample container has not been tampered with or opened. The individual in possession of the sample (s) will sign and date the seal, affixing it in such a manner that the container cannot be opened without breaking the seal. The name of this individual, along with a description of the sample packaging, will be noted in the field logbook.

QAPP Worksheet #14: Summary of Project Tasks (Concluded)

Assessment/Audit Tasks: No performance audit of field operations is anticip ated at this time. If conducted, performance and system audit will be in accordance with the project plan.

Data Review Tasks: All data will be validated by RST 3 Subcontracted data validator.

Laboratory analytical results will be assessed by t he data reviewer for compliance with required precision, accuracy, completeness, representativeness, and sensitivity.

QAPP Worksheet #16: Project Schedule/Timeline Table

Activities	Organization	Dates (MM/DD/YY) Anticipated Date(s) of Initiation	Dates (MM/DD/YY) Anticipated Date of Completion	Deliverable	Deliverable Due Date
Preparation of QAPP	RST 3 Contractor Site Project Manager	Prior to sampling date	5/4/2017	QAPP	5/5/2017
Review of QAPP	RST 3 Contractor QAO and/or Group Leader	Prior to sampling date	5/4/2017	Approved QAPP	5/5/2017
Preparation of Health and Safety Plan	RST 3 Contractor Site Project Manager	Prior to sampling date	5/5/2017	HASP	5/5/2017
Procurement of Field Equipment	RST 3 Contractor Site Project Manager and/or Equipment Officer	Prior to sampling date	5/5/2017	NA	5/8/2017
Laboratory Request	Not Applicable	TBD	TBD	TBD	TBD
Field Reconnaissance/Access	RST 3 Contractor Site Project Manager; or EPA Region II OSC	5/8/2017	5/12/2017	NA	NA
Collection of Field Samples	RST 3 Contractor Site Project Manager	5/8/2017	5/12/2017	NA	NA
Laboratory Electronic Data Received	RST 3 Contractor and EPA Region 2 DEWSA	TBD	TBD	TBD	TBD
Laboratory Package Received	RST 3 Contractor and EPA Region 2 DEWSA	TBD	TBD	TBD	TBD
Validation of Laboratory Results	RST 3 Contractor and EPA Region 2 DEWSA	TBD	TBD	TBD	TBD
Data Evaluation/ Preparation of Final Report	RST 3 Contractor Site Project Manager	TBD	TBD	TBD	TBD

NA – Not Applicable,
TBD – To be determined

QAPP Worksheet #17: Sampling Design and Rationale

Soil Sampling:

RST 3 subcontractor will advance test pits at locations throughout the Site for soil/slag/rock sampling. Prior to mobilizing to the Site, RST 3 subcontractor will contact Dig Safely New York to conduct a subsurface utility mark out of the existing underground public utilities. In addition, RST 3 subcontractor will perform a private utility mark out to locate any underground utilities at selected sampling locations before advancing any test pit. Based on results from prior radiological survey performed at the Site, test pit locations will be preselected by the EPA OSC and marked out on-site with spray paint at location with asphalt surfaces or flagged at locations in soil. Prior to advancing test pits located on asphalt surfaces, the asphalt will be saw-cut by RST 3 subcontractor in a 4 foot by 4 foot area and removed to expose the soil. Utilizing a mini excavator, RST 3 subcontractor will advance up to 20 test pits to a depth of 4 feet bgs at selected test pit locations in on-site AOCs, including Area 1 through Area 5, Area 7, and a background area of the Site.

Upon completing each test pit, RST 3 will document the soil characteristics, description, and depths of visible slag/rock material within each test pit in order to provide reference information for estimating volumes of waste to be potentially removed from the area. In accordance with EPA's ERT/SERAS contractor's SOP No. 2001: *General Field Sampling Guidelines* and SOP No. 2012: *Soil Sampling*, RST 3 will collect up to 168 heterogeneous soil/slag/rock samples, including eight field duplicates, from all the test pits throughout the Site. The samples will be collected from the side walls of each test pit at 6 inch intervals from 0-6, 6-12, 12-18, 18-24, 24-30, 30-36, 36-42, and 42-48 inches bgs. To reduce chances of cross contamination between sampling intervals, the samples will be collected in reverse order using dedicated disposable scoops starting from the deepest interval upwards to the surface. Fresh nitrile gloves will be donned between each sampling interval and location. Prior to sample collection at each interval, the bottom of the scoop will be used to scrape each area of the sidewall to be sampled in order to expose fresh soil/slag/rocks which will be collected, placed directly into dedicated re-sealable plastic bags, and homogenized. The sample identification information, date and time of sample collection will be recorded on the outside of each dedicated re-sealable plastic bag. Field duplicates and additional sample volumes for MS/MSD analysis will be collected at a frequency of one per 20 field samples.

Once all samples have been collected within each test pit, RST 3 subcontractor will relocate the IDW to Area 7 where it will be staged on and securely covered with polyethylene sheeting. For safety, RST 3 subcontractors will backfill each test pit as soon as possible with fill material provided on-site in the form of pre-analyzed soil stockpile. All the backfilled test pit locations on asphalt surfaces will be restored by RST 3 subcontractor as close as possible to pre-existing conditions with asphalt over a gravel base.

The soil/slag/rock samples will be transferred into 16 oz. poly containers and analyzed on site utilizing a HPGe detector. Based on the results generated by the HPGe detector, EPA will determine the samples to be shipped offsite for laboratory analysis. The samples will be collected for definitive data and QA/QC purposes, and will be analyzed in the laboratory for Bi-212, Cs-137, K-40, Pb-212, Pa-234, Ra-226, Ra-228, Th-228, Th-230, Th-232, Th-234, Tl-208, U-233/234, U235/236, U235, and U238.

QAPP Worksheet #17: Sampling Design and Rationale (Concluded)

The following laboratories will provide the analyses indicated:

Lab Name/Location	Sample Type	Parameters
TBD	Soil/Slag/Rocks	Bi-212, Cs-137, K-40, Pb-212, Pa-234, Ra-226, Ra-228, Th-228, Th-230, Th-232, Th-234, Tl-208, U-233/234, U235/236, U235, and U238.

TBD – To be determined
Refer to Worksheet #20 for QA/QC samples, sampling methods, and SOPs.

QAPP Worksheet #18: Sampling Locations and Methods/SOP Requirements Table

Matrix	Sampling Location(s)	Units	Analytical Group(s)	Concentration Level	No. of Samples (identify field duplicates)	Sampling SOP Reference	Rationale for Sampling Location
Soil/Slag/Rock	20	pCi/g	Isotopic Thorium, Isotopic Uranium, and other alpha emitting actinides	Low/Medium	160 samples, 8 duplicates. 1/20 sample per matrix	SOP# 2001 2012	Determine contaminants
Soil/Slag/Rock	20	pCi/g	Radium-226, Radium-228 and other gamma emitting radioisotopes	Low/Medium	160 samples, 8 duplicates. 1/20 sample per matrix	SOP# 2001 2012	Determine contaminants

The website for EPA-ERT SOPs is: https://response.epa.gov/site/doc_list.aspx?site_id=2107&category=Field%20Activities

QAPP Worksheet #19: Analytical SOP Requirements Table

Matrix	No. of Samples	Analytical Group	Concentration Level	Analytical / Preparation Method SOP Reference[1]	Containers (number, size, and type)	Sample volume[2] (units)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation / analysis)
Soil	168	Isotopic Uranium	Low/Medium	TBD	1x16oz Poly Container	300	None	None
		Isotopic Thorium	Low/Medium	TBD				
		Gamma spectroscopy	Low/Medium	TBD				

[1] Refer to the Analytical SOP References table (Worksheet #23).

[2] The minimum sample size is based on analysis allowing for sufficient sample for reanalysis. Additional volume is needed for the laboratory Matrix Spike/Matrix Spike Duplicate sample analysis.

TBD – To be determined

QAPP Worksheet #20: Field Quality Control Sample Summary Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation SOP Reference	No. of Sampling Locations	No. of Field Duplicate Pairs	No. of Extra Volume Laboratory QC (e.g., MS/MSD) Samples[1]	No. of Rinsate Blanks[1]	No. of Trip. Blanks	No. of PE Samples
Soil	Isotopic Uranium	Low/Medium	TBD	20	1 per 20 samples	1 per 20 samples	NR	NR	NR
	Isotopic Thorium	Low/Medium	TBD	20	1 per 20 samples	1 per 20 samples	NR	NR	NR
	Gamma spectroscopy	Low/Medium	TBD	20	1 per 20 samples	1 per 20 samples	NR	NR	NR

NR – Not Required
[1] Only required if non-dedicated sampling equipment to be used.
TBD – To be determined

QAPP Worksheet #21: Project Sampling SOP References Table

Reference Number	Title, Revision Date and/or Number	Originating Organization	Equipment Type	Modified for Project Work? (Y/N)	Comments
SOP#: 2001	General Field Sampling Guidelines (all media); Rev. 0.1, June 7, 2013	EPA ERT/SERAS	Site Specific	N	--
SOP#: 2012	Soil Sampling; Rev. 0.1, July 11, 2001	EPA ERT/SERAS	plastic scoops, aluminum trays, and appropriate sample jars	N	--

See attachment B for EPA ERT/SERAS SOP # 2001 and 2012.

QAPP Worksheet #22: Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Calibration Activity	Maintenance Activity	Testing/ Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
*Ludlum Model 2241 with 3x3 Gamma Scintillator	EPA Equipment office	EPA Equipment office	EPA Equipment office	EPA Equipment office	EPA Equipment office	EPA Equipment office	EPA Equipment office	NA
*Ludlum Model 2241 with 2x2 Gamma Scintillator	EPA Equipment office	EPA Equipment office	EPA Equipment office	EPA Equipment office	EPA Equipment office	EPA Equipment office	EPA Equipment office	NA
*High-Purity Germanium Detector (HPGe)	EPA Equipment office	EPA Equipment office	EPA Equipment office	EPA Equipment office	EPA Equipment office	EPA Equipment office	EPA Equipment office	NA
Trimble® GeoXT™ handheld								

*Equipment provided, calibrated, maintained, tested, and inspected by EPA.

QAPP Worksheet #26: Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): RST 3 Site Project Manager, Weston Solutions, Inc., Region II
Sample Packaging (Personnel/Organization): RST 3 Site Project Manager and sampling team members, Weston Solutions, Inc., Region II
Coordination of Shipment (Personnel/Organization): RST 3 Site Project Manager, sampling team members, Weston Solutions, Inc., Region II
Type of Shipment/Carrier: FedEx
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Sample Custodian, RST 3-Procured Non-RAS Laboratory
Sample Custody and Storage (Personnel/Organization): Sample Custodian, RST 3-Procured Non-RAS Laboratory
Sample Preparation (Personnel/Organization): Sample Custodian, RST 3-Procured Non-RAS Laboratory
Sample Determinative Analysis (Personnel/Organization): Sample Custodian, RST 3-Procured Non-RAS Laboratory
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): Soil samples to be held on-site for HPGe analysis pending EPA approval for laboratory analysis.
Sample Extract/Digestate Storage (No. of days from extraction/digestion): As per analytical methodology; see Worksheet #19
SAMPLE DISPOSAL
Personnel/Organization: Sample Custodian, RST 3-Procured Non-RAS Laboratory
Number of Days from Analysis: Until analysis and QA/QC checks are completed; as per analytical methodology; see Worksheet #19.

QAPP Worksheet #27: Sample Custody Requirements

Sample Identification Procedures Each sample collected by Region II RST 3 will be identified with a site prefix or property number (HTC or P001), AOC number (A01)/sample location number (001), the matrix identifier of the sample collected (S for soil sample), specifically for soil samples, the depth interval from where the sample was collected will be identified as a range (0612), and the sample number (01). The last number will represent the sample number collected from each location. Duplicate samples will be identified in the same manner but will be the next sequential sample number (in most cases 02). e.g. NFB-A01-S001-0612-01: whereas, NFB = Site Prefix, A01 = AOC in Area 1, S001 = Soil Sample Location 001, 0612 = Soil sample collected at 6 to 12 feet, 01 = Sample Number 01 Location of the sample collected will be recorded in the project database and site logbook. A duplicate sample will be identified in the same manner as other samples and will be distinguished and documented in the field logbook. Each sample will also be labeled with a non-CLP assigned number. Depending on the type of sample, additional information such as sampling round, date, etc. will be added.
Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory): Each sample will be individually identified and labeled after collection, then sealed with custody seals and enclosed in a plastic cooler. The sample information will be recorded on chain-of custody (COC) forms, and the samples shipped to the appropriate laboratory via overnight delivery service or courier. Chain-of-custody records must be prepared in Scribe to accompany samples from the time of collection and throughout the shipping process. Each individual in possession of the samples must sign and date the sample COC Record. The chain-of-custody record will be considered completed upon receipt at the laboratory. A traffic report and chain-of-custody record will be maintained from the time the sample is taken to its final deposition. Every transfer of custody must be noted and signed for, and a copy of this record kept by each individual who has signed. When samples are not under direct control of the individual responsible for them, they must be stored in a locked container sealed with a custody seal. Specific information regarding custody of the samples projected to be collected on the weekend will be noted in the field logbook. The chain-of-custody record should include (at minimum) the following: 1) Sample identification number; 2) Sample information; 3) Sample location; 4) Sample date; 5) Sample Time; 6) Sample Type Matrix; 7) Sample Container Type; 8) Sample Analysis Requested; 9) Name(s) and signature(s) of sampler(s); and 10) Signature(s) of any individual(s) with custody of samples. A separate chain-of-custody form must accompany each cooler for each daily shipment. The chain-of-custody form must address all samples in that cooler, but not address samples in any other cooler. This practice maintains the chain-of-custody for all samples in case of mis-shipment.

QAPP Worksheet #27: Sample Custody Requirements (Concluded)

Laboratory Sample Custody Procedures (receipt of samples, archiving, and disposal): A sample custodian at the laboratory will accept custody of the shipped samples, and check them for discrepancies, proper preservation, integrity, etc. If noted, issues will be forwarded to the laboratory manager for corrective action. The sample custodian will relinquish custody to the appropriate department for analysis. At this time, no samples will be archived at the laboratory. Disposal of the samples will occur only after analyses and QA/QC checks are completed.

QQAPP Worksheet #29: Project Documents and Records Table

Sample Collection Documents and Records	Analysis Documents and Records	Data Assessment Documents and Records	Data Assessment Documents and Records	Other
Field Notes Digital Photographs Chain-of-Custody (COC) Records Air Bills Copies of Pertinent e-mails. Field Instrument Records	Record of Field Instrument. Measurements and Radiological Readings. Radiological Dosimetry Records. Corrective Action Reports. Radiological Instrument Calibration Readings.	Copies of all Analytical Data Deliverables; hard copies of raw data are archived; The raw data files from the laboratory include Analytical Instrument Calibration Records, COC Records, and Sample Preparation and Analysis Files, Sample Receipt Records	Copies of all Analytical Data Deliverables; hard copies of raw data are archived; The raw data files from the laboratory include Analytical Instrument Calibration Records, COC Records, and Sample Preparation and Analysis Files, Sample Receipt Records	Staff Health and Safety Records; CLP Request Form and RST 3 Analytical Request Form

QAPP Worksheet #31: Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (Title and Organizational Affiliation)	Person(s) Responsible for Responding to Assessment Findings (Title and Organizational Affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions (Title and Organizational Affiliation)	Person(s) Responsible for Monitoring Effectiveness of Corrective Actions (Title and Organizational Affiliation)
Laboratory Technical Systems/ Performance Audits	Every year	External	Regulatory Agency	Regulatory Agency	RST 3-Procured Laboratory	RST 3-Procured Laboratory	EPA, State, NRC, or other Regulatory Agency
Performance Evaluation Samples	Every year	External	Regulatory Agency	Regulatory Agency	RST 3-Procured Laboratory	RST 3-Procured Laboratory	EPA, State, NRC, or other Regulatory Agency
Proficiency Testing	Semiannually	External	NELAC	PT provider	Lab Personnel	Lab Personnel	Lab QA Officer
NELAC	Every two years	External	NELAC	NELAC Representative	Lab QA Officer	Lab Personnel	NELAC Representative
Internal Audit	Annually	Internally	Pace Analytical Services	Lab QA Officer	Lab Personnel	Lab Personnel	Lab QA Officer

NRC: Nuclear Regulatory Commission

QAPP Worksheet #32: Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (Name, Title, Org.)	Timeframe for Response
Project Readiness Review	Checklist or logbook entry	RST 3 Site Project Manager, Weston Solutions, Inc.	Immediately to within 24 hours of review	Checklist or logbook entry	RST 3 Site Project Leader	Immediately to within 24 hours of review
Field Observations/ Deviations from Work Plan	Logbook	RST 3 Site Project Manager, Weston Solutions, Inc. and EPA OSC	Immediately to within 24 hours of deviation	Logbook	RST 3 Site Project Manager and EPA OSC	Immediately to within 24 hours of deviation
Laboratory Technical Systems/ Performance Audits	Written Report	RST 3-Procured Laboratory	30 days	Letter	RST 3-Procured Laboratory	14 days
On-Site Field Inspection	Written Report	QAO/HSO Weston Solutions, Inc.	7 calendar days after completion of the audit	Letter/Internal Memorandum	Weston's regional QAO and/or EPA OSC	To be identified in the cover letter of the report

QAPP Worksheet #33: QA Management Reports Table

Type of Report	Frequency (Daily, weekly, monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (Title and Organizational Affiliation)	Report Recipient(s) (Title and Organizational Affiliation)
RST 3-Procured Laboratory Data (preliminary)	As performed	Two weeks from the sampling date	RST 3-Procured Laboratory	RST 3 Data Validator and RST 3 Site Project Manager
RST 3-Procured Laboratory Data (validated)	As performed	Up to 14 days after receipt of preliminary data	RST 3 Data Validators	RST 3 Site Project Manager and OSC, EPA Region II
On-Site Field Inspection	As performed	7 calendar days after completion of the inspection	RST 3 Site Safety Officer	RST 3 Site Project Manager
Field Change Request	As required per field change	Three days after identification of need for field change	RST 3 Site Project Manager	EPA, Region II OSC
Final Report	As performed	2 weeks after receipt of EPA approval of data package	RST 3 Site Project Manager	EPA, Region II OSC

QAPP Worksheet #34: Verification (Step I) Process Table

Verification Input	Description	Internal/ External	Responsible for Verification (Name, Organization)
Site/field logbooks	Field notes will be prepared daily by the RST 3 Site Project Manager and will be complete, appropriate, legible and pertinent. Upon completion of field work, logbooks will be placed in the project files.	I	RST 3 Site Project Manager
Chains of custody	COC forms will be reviewed against the samples packed in the specific cooler prior to shipment. The reviewer will initial the form. An original COC will be sent with the samples to the laboratory, while copies are retained for (1) the Sampling Trip Report and (2) the project files.	I	RST 3 Site Project Manager
Sampling Trip Reports	STRs will be prepared for each week of field sampling [for which samples are sent to an EPA CLP RAS laboratory]. Information in the STR will be reviewed against the COC forms, and potential discrepancies will be discussed with field personnel to verify locations, dates, etc.	I	RST 3 Site Project Manager
Laboratory analytical data package	Data packages will be reviewed/verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal.	E	RST 3-Procured Laboratories
Laboratory analytical data package	Data packages will be reviewed as to content and sample information upon receipt by EPA.	I	RST 3 Site Project Manager
Final Sample Report	The project data results will be compiled in a sample report for the project. Entries will be reviewed/verified against hardcopy information.	I	RST 3 Site Project Manager

QAPP Worksheet #35: Validation (Steps IIa and IIb) Process Table

Step IIa/IIb	Validation Input	Description	Responsible for Validation (Name, Organization)
IIa	SOPs	Ensure that the sampling methods/procedures outlined in QAPP were followed, and that any deviations were noted/approved.	RST 3 Site Project Manager
IIb	SOPs	Determine potential impacts from noted/approved deviations, in regard to PQOs.	RST 3 Site Project Manager
IIa	Chains of custody	Examine COC forms against QAPP and laboratory contract requirements (e.g., analytical methods, sample identification, etc.).	RST 3- procured laboratory - RST 3 data validator
IIa	Laboratory data package	Examine packages against QAPP and laboratory contract requirements, and against COC forms (e.g., holding times, sample handling, analytical methods, sample identification, data qualifiers, QC samples, etc.).	RST 3- procured laboratory - RST 3 data validator
IIb	Laboratory data package	Determine potential impacts from noted/approved deviations, in regard to PQOs. Examples include PQLs and QC sample limits (precision/accuracy).	RST 3- procured laboratory - RST 3 data validator
IIb	Field duplicates	Compare results of field duplicate (or replicate) analyses with RPD criteria	RST 3- procured laboratory - RST 3 data validator

QAPP Worksheet #36
Validation (Steps IIa and IIb) Summary Table

Step IIa/IIb	Matrix	Analytical Group	Validation Criteria	Data Validator (title and organizational affiliation)
IIa / IIb	Soil/Slag/Rock	Radiological Parameters	Refer to methods listed in worksheet # 19 & 20	RST 3 subcontractor Data Validation Personnel

QAPP Worksheet #37: Usability Assessment

Summarize the usability assessment process and all procedures, including interim steps and any statistics, equations, and computer algorithms that will be used: Data, whether generated in the field or by the laboratory, are tabulated and reviewed for Precision, Accuracy, Representativeness, Completeness, and Comparability (PARCCS) by the SPM for field data or the data validator for laboratory data. The review of the PARCC Data Quality Indicators (DQI) will compare with the DQO detailed in the site-specific QAPP, the analytical methods used and impact of any qualitative and quantitative trends will be examined to determine if bias exists. A hard copy of field data is maintained in a designated field or site logbook. Laboratory data packages are validated, and final data reports are generated. All documents and logbooks are assigned unique and specific control numbers to allow tracking and management.
Questions about Non-CLP data, as observed during the data review process, are resolved by contacting the respective site personnel and laboratories as appropriate for resolution. All communications are documented in the data validation record with comments as to the resolution to the observed deficiencies.

Where applicable, the following documents will be followed to evaluate data for fitness in decision making: EPA QA/G-4, *Guidance on Systematic Planning using the Data Quality Objectives Process,* EPA/240/B-06/001, February 2006, and EPA QA/G-9R, *Guidance for Data Quality Assessment*, A reviewer's Guide EPA/240/B-06/002, February 2006.

Describe the evaluative procedures used to assess overall measurement error associated with the project:
As delineated in the ***Uniform Federal Policy for Implementing Environmental Quality Systems: Evaluating, Assessing and Documenting Environmental Data Collection and Use Programs Part 1: UFP-QAPP (EPA-505-B-04-900A, March 2005); Part 2A: UFP-QAPP Workbook (EPA-505-B-04-900C, March 2005); Part 2B: Quality Assurance/Quality Control Compendium: Non-Time Critical QA/QC Activities (EPA-505-B-04-900B, March 2005);*** "Graded Approach" will be implemented for data collection activities that are either exploratory or where specific decisions cannot be identified, since this guidance indicates that the formal DQO process is not necessary.

The data will be evaluated to determine whether they satisfy the PQO for the project. The validation process determines if the data satisfy the QA criteria. After the data pass the data validation process, comparison results with the PQO is done.

QAPP Worksheet #37: Usability Assessment (Concluded)

The analytical data that will be generated from this event will be compared with the EPA Site-Specific Action Level for each radionuclide, and would enable EPA to determine the volume of contaminated soil that will be excavated from the various AOCs designated for the ongoing Removal Action being conducted to address the presence of radiation-containing material on the Site

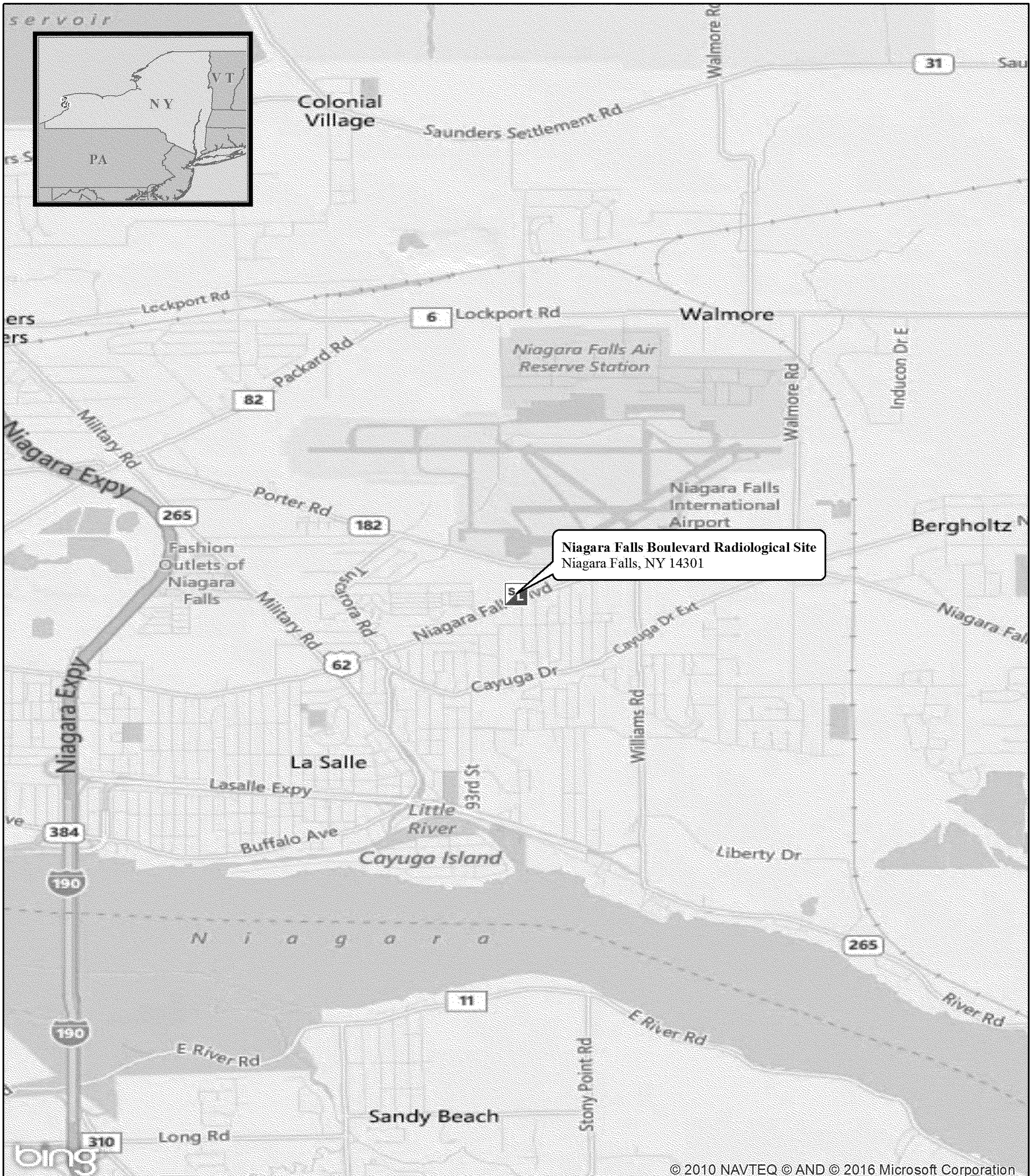
Identify the personnel responsible for performing the usability assessment: Site Project Manager, Data Validation Personnel, and EPA, Region II OSC

Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies:

A copy of the most current approved QAPP, including any graphs, maps and text reports developed will be provided to all personnel identified on the distribution list.

ATTACHMENT A

Figure 1: Site Location Map
Figure 2: Proposed Test Pit Location Map



Legend

Site Location

N

0 0.275 0.55 1.1 1.65 2.2 Miles

Weston Solutions, Inc.
Federal East Division

In Association With
Scientific and Environmental Associates, Inc., Environmental Compliance Consultants, Inc., Avatar Environmental, LLC, On-Site Environmental, Inc.and Sovereign Consulting, Inc

DATE MODIFIED: 9/6/2016

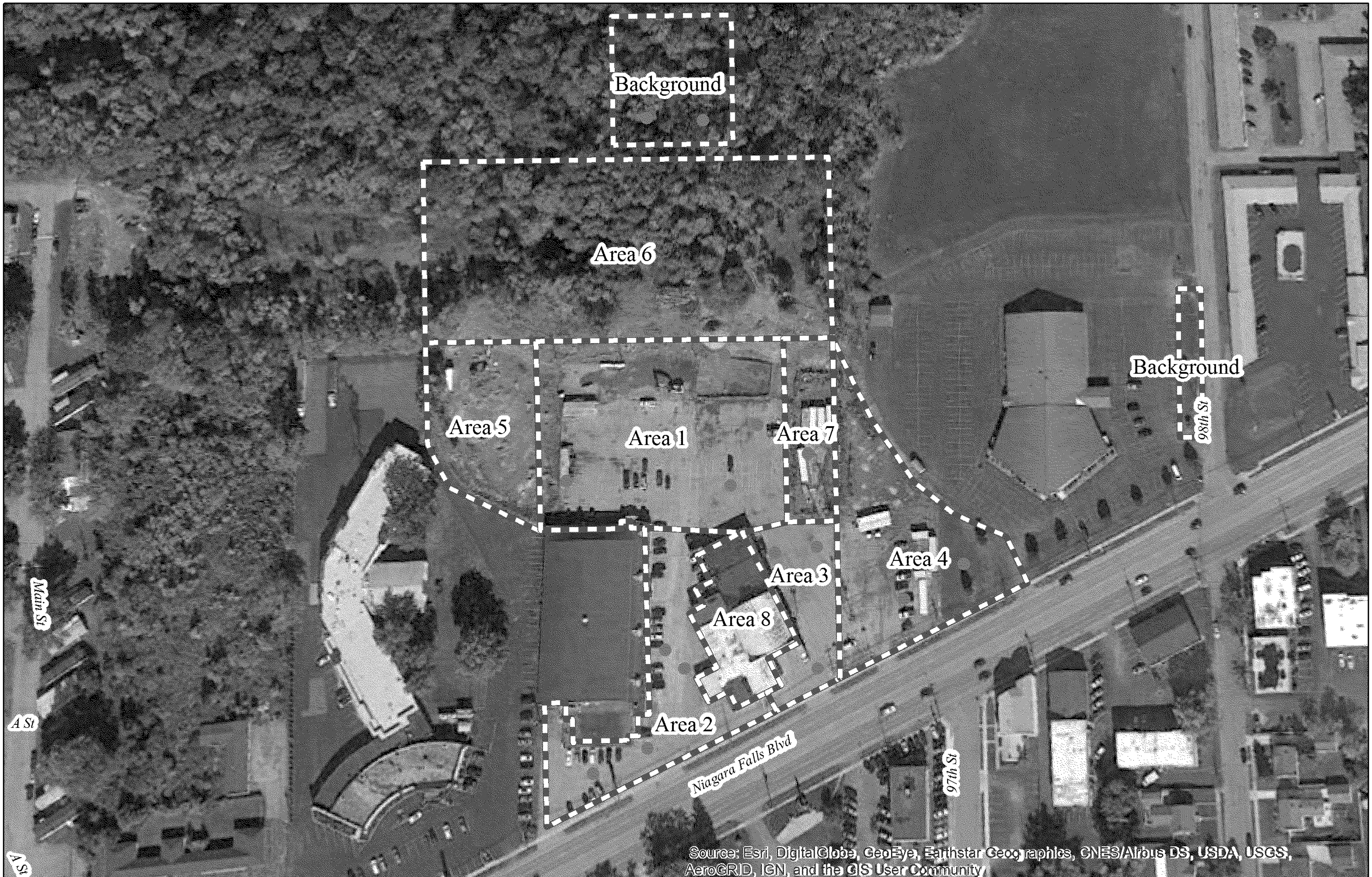
Figure 1:
Site Location Map

Niagara Falls Boulevard Radiological Site
Niagara Falls, New York

U.S. ENVIRONMENTAL PROTECTION AGENCY
REMOVAL SUPPORT TEAM 3
CONTRACT # EP-S2-14-01

GIS ANALYST:	T. Benton
EPA OSC:	E. Daly
RST SPM:	P. Lisichenko
FILENAME:	140723_SITELOCATIONMAP.MXD

\\FSED2DATA1\GISDATA\RST_3\00070011\MXD\140723_SITELOCATIONMAP.MXD



Legend

Work Area

Proposed Test Pit Location

N

0 80 160 320 480 640 Feet

Weston Solutions, Inc.

In association with
Scientific and Environmental Associates, Inc.,
Avatar Environmental, LLC, Environmental Compliance Consultants,
On-Site Environmental, Inc., and Sovereign Consulting, Inc.

Figure 2: Proposed Test Pit Location Map

NIAGARA FALLS BOULEVARD RADIOLOGICAL SITE
NIAGARA FALLS, NEW YORK

U.S. ENVIRONMENTAL PROTECTION AGENCY
REMOVAL SUPPORT TEAM 3
CONTRACT # EP-S2-14-01

DATE MODIFIED: 5/4/2017

GIS ANALYST:	T. BENTON
EPA OSC:	E. DALY
RST SPM:	B. NWOSU
FILENAME:	170504_NFB_PropSampleLoc.mxd

ATTACHMENT B

Sampling SOPs

EPA/ERT SOP # 2001 and 2012

CONTENTS

Complete Rewrite: SOP #2001; Revision 1.0; 03/15/13; U.S. EPA Contract EP-W-09-031

SUPERCEDES: SOP #2001; Revision 0.0; 08/11/94; U.S. EPA Contract 68-C4-0022

1.0 OBJECTIVE

The objective of this standard operating procedure (SOP) is to describe the general field sampling techniques and guidelines that will assist the Scientific Engineering Response and Analytical Services (SERAS) personnel in planning, choosing sampling strategies and sampling locations, and frequency of Quality Control (QC) samples for proper assessment of site characteristics. The ultimate goal is to ensure data quality during field collection activities.

2.0 APPLICABILITY

This SOP applies to the collection of aqueous and non-aqueous samples for subsequent laboratory analysis to determine the presence, type, and extent of contamination at a site.

3.0 DESCRIPTION

Representative sampling ensures that a sample or a group of samples accurately reflect the concentration of the contaminant at a given time and location. Depending on the contaminant of concern and matrix, several variables may affect the representativeness of the samples and subsequent measurements. Environmental variability due to non-uniform distribution of the pollutant due to topographic, meteorological and hydrogeological factors, changes in species, and dispersion of contaminants and flow rates contribute to uncertainties in sampling design.

Determining the sampling approach depends on what is known about the site from prior sampling (if any) and the site history, variation of the contaminant concentrations throughout a site, potential migration pathways, and human and environmental receptors. The objectives of an investigation determine the appropriate sampling design.

The frequency of sampling and the specific sample locations that are required must be defined in the site-specific Quality Assurance Project Plan (QAPP).

3.1 Planning Stage

The objectives of an investigation are established and documented in the site-specific QAPP. The technical approach including the media/matrix to be sampled, sampling equipment to be used, sampling design and rationale, and SOPs or descriptions of the procedure to be implemented are included in the QAPP. Refer to the matrix-specific SOPs for sampling techniques which include the equipment required for sampling.

During the planning stage, the data quality objectives (DQOs) will be determined. In turn, the project's DQOs will determine the need for screening data or definitive data. Screening data supports an intermediate or preliminary decision but eventually is supported by definitive data before the project is complete (i.e., placement of monitor wells, estimation of extent of contamination). Definitive data is suitable for final decision making, has defined precision and accuracy requirements and is legally defensible (i.e., risk assessments, site closures).

3.2. Sampling Design

Representative sampling approaches include judgmental, random, systematic grid, systematic simple random, stratified random and transect sampling. Sampling designs may be applied to soil, sediment and water; however, the random and systematic random approaches are not practical for sampling water systems, especially flowing water systems.

3.2.1 Judgmental Sampling

Judgmental sampling is the subjective selection of sampling locations based on the professional judgment of the field team. This method is useful to locate and to identify potential sources of contamination. It may not be representative of the full site and is used to document worst case scenarios. For example, groundwater sampling points are typically chosen based on professional judgment, whether permanently installed wells or temporary well points.

3.2.2 Systematic Sampling

Systematic grid sampling involves the collection of samples at fixed intervals when the contamination is assumed to be randomly distributed. A random point is chosen as the origin for the placement of the grid. A grid is constructed over a site and samples are collected from the nodes (where the grid lines intersect). Depending on the number of samples that are required to be collected, the distance between the sampling locations can be adjusted. The representativeness of the sampling may be improved by shortening the distance between sample locations.

Systematic random sampling is used for estimating contaminant concentrations within grid cells. Instead of sampling at each node, a random location is chosen within each grid cell. The systematic grid and random sampling approaches are useful for delineating the extent of contamination, documenting the attainment of clean-up goals, and evaluating and determining treatment and disposal options.

Transect sampling involves one or more transect lines established across the site. Samples are collected at systematic intervals along the transect lines. The number of samples to be collected and the length of the transect line determines the spacing between the sampling points. This type of sampling design is useful for delineating the extent of contamination at a particular site, for documenting the attainment of clean-up goals, and for evaluating and determining treatment and disposal options.

3.2.3 Simple and Stratified Random Sampling

Statistical random sampling includes simple, stratified and systematic sampling. Simple random sampling is appropriate for estimating means and total concentrations, if the site or population does not contain a major trend or pattern of contamination. A statistician will generate the sampling locations based on sound statistical methods. Stratified random sampling is a useful tool for estimating average contaminant concentrations and total amounts of contaminants within specified strata and across the entire site. It is useful when a heterogeneous population or area can be broken down into regions with less variability within the boundaries of a stratum then between the strata. Additionally, strata can be defined based on the decisions that will be made. This type of sampling design uses historical information, known ecological and human receptors, soil type, fate and transport mechanism and other ecological factors to divide the sampling area into smaller regions or strata. Sampling locations are selected from each stratum using random sampling.

The simple random sampling approach is applied when there are many sample locations and the concentrations are assumed to be homogeneous across a site with respect to the parameter(s) that are going to be analyzed or monitored for. The stratified random sampling approach is useful for sampling drums, evaluating and determining treatment and disposal options, and locating and identifying sources of contamination.

3.3 Sampling Techniques

Sampling is the selection of a representative portion of a larger population or body. The primary objective of all sampling activities is to characterize a site accurately in a way that the impact on human health and the environment can be evaluated appropriately.

3.3.1 Sample Collection Techniques

Sample collection techniques may be either grab or composite. A grab sample is a discrete aliquot representative of a specific location at a given time and collected all at once from one location. The representativeness of such samples is defined by the nature of the materials that are sampled. Samples collected for volatile organic compounds (VOCs) are always grab samples and are never homogenized. Composite samples are non-discrete samples composed of more than one specific aliquot collected at selected sampling locations. Composite samples must be homogenized by mixing prior to putting the sample into containers. Composite samples can, in certain instances, be used as an alternative to analyzing a number of individual grab samples and calculating an average value. Incremental sampling conducted over a grid is a special case of composite sampling and is detailed in SOP #2019, *Incremental Soil Sampling*. Choice of collecting discrete or composite samples is based on project's DQOs.

3.3.2 Homogenization

Mixing of soil and sediment samples is critical to obtain a representative sample. An adequate volume/weight of sample is collected and placed in a stainless steel or Teflon® container, and is thoroughly mixed using a spatula or spoon made of an inert material. Once the sample is thoroughly mixed the sample is placed into sample containers specific for an analysis. Avoid the use of equipment made of plastic or polyvinyl chloride (PVC) when sampling for organic compounds when the reporting limit (RL) is in the parts per billion (ppb) or parts per trillion (ppt) ranges. Refer to SERAS SOP #2012, *Soil Sampling*, for more details on homogenization.

3.3.3 Filtration

In-line filters are used specifically for collecting groundwater samples for dissolved metals analysis and for filtering large volumes of turbid groundwater. Groundwater samples collected for VOCs are typically not filtered due to potential VOC losses. Filtering groundwater is performed to remove silt particulates from samples to prevent interference with the laboratory analysis. The filters used in groundwater sampling are either cartridge type filters inserted into a reusable housing, or are self-contained and disposable. Filter chambers are usually made of polypropylene housing an inert filtering material that removes particles larger than 0.45 micrometers (μm). Refer to SERAS SOP

#2007, *Groundwater Well Sampling* and SERAS SOP #2013, *Surface Water Sampling*, for more details on filtration techniques.

3.4 Quality Assurance /Quality Control Samples

QA/QC samples provide an evaluation of both the laboratory's and the field sampling team's performance. Including QA/QC samples in a sampling design allows for identifying and measuring sources of error potentially introduced from the time of sample container preparation through analysis. The most common QA/QC samples collected in the field are collocated field duplicates, field replicates, equipment blanks, field blanks and trip blanks. Extra volume/mass is collected for a matrix spike/matrix spike duplicate (MS/MSD) at a frequency of 5% (one in 20 samples). Spiking is performed in the laboratory. For additional information or other QA/QC samples pertinent to sample analysis, refer to SERAS SOP #2005, *Quality Assurance/Quality Control Samples*.

Collocated field duplicates may be collected based on site objectives and used to measure variability associated with the sampling process including sample heterogeneity, sampling methodology, and analytical procedures. Field replicates are field samples obtained from one location, homogenized, and divided into separate containers. This is useful for determining whether the sample has been homogenized properly. Equipment blanks (also known as rinsate blanks) are typically collected at a rate of one per day. The equipment blank is used to evaluate the relative cleanliness of non-dedicated equipment.

3.5 Sample Containers, Preservation, Storage and Holding Times

The amount of sample to be collected, the proper sample container type (i.e., glass, plastic), chemical preservation, and storage requirements are dependent on the matrix sampled and the analyses to be conducted. This information is provided in SERAS SOP #2003, *Sample Storage, Preservation, and Handling*. Field personnel need to be cognizant of any short holding times that warrant immediate shipment/transfer to the laboratory.

3.6 Documentation

Field conditions and site activities must be documented. Scribe will be used to document sample locations and generate chain of custody records. Other field measurements not typically entered into Scribe will be documented in a site-specific logbook or in a personal logbook. All sample documentation will be maintained in accordance with SERAS SOP #2002, *Sample Documentation* and SERAS SOP #4005, *Chain of Custody Procedures.*

4.0 RESPONSIBILITIES

4.1 SERAS Task Leaders

Task Leaders (TLs) are responsible for the overall management of the project. Task Leader responsibilities include ensuring that field personnel are well informed of the sampling requirements for a specific project and that SOP and QA/QC procedures stated in the site-specific QAPP are adhered to, issuing a Field Change Form that documents any changes to sampling activities after the QAPP has been approved and maintaining sample documentation.

4.2 SERAS Field Personnel

Field personnel are responsible for reading the QAPP prior to site activities and performing sample collection activities as written. They are responsible for notifying the TL of deviations from sample collection protocols which occurred during the execution of sampling activities. Field staff will collect samples and prepare documentation in accordance with SERAS SOP #2002, *Sample Documentation*. In addition, field personnel are responsible for reading and conforming to the approved site-specific Health and Safety Plan (HASP).

4.3 SERAS Program Manager

The SERAS Program Manager is responsible for the overall technical and financial management of the project.

4.4 SERAS QA/QC Officer

The QA/QC Officer is responsible for reviewing this SOP and ensuring that the information in this SOP is updated on a timely basis. Compliance to this SOP may be monitored by either conducting a field audit or reviewing deliverables prepared by the SERAS TL.

4.5 Health and Safety (H&S) Officer

The H&S Officer is responsible for ensuring that a HASP has been written in conformance with SOP # 3012, *SERAS Health and Safety Guidelines for Field Activities* and approved prior to field activities. Additionally, the H& S Officer is responsible for ensuring that SERAS site personnel's H&S training is current as per SOP # 3006, *SERAS Field Certification Program* and that their medical monitoring is current as per *SERAS SOP #3004, SERAS Medical Monitoring Program.*

CONTENTS

*These sections affected by Revision 1.0.

SUPERCEDES: SOP #2012; Revision 0.0; 2/18/00; U.S. EPA Contract 68-C99-223.

1.0 SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to describe procedures for the collection of representative surface soil samples. Sampling depths are assumed to be those that can be reached without the use of a drill rig, direct-push technology, or other mechanized equipment (except for a back-hoe). Sample depths typically extend up to 1-foot below ground surface. Analysis of soil samples may define the extent of contamination, determine whether concentrations of specific contaminants exceed established action levels, or if the concentrations of contaminants present a risk to public health, welfare, or the environment.

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent upon site conditions, equipment limitations, or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with a final report.

Mention of trade names or commercial products does not constitute United States Environmental Protection Agency (U.S. EPA) endorsement or recommendation for use.

2.0 METHOD SUMMARY

Surface soil samples can be used to investigate contaminants that are persistent in the near surface environment. Contaminants that are detected in the near surface environment may extend to considerable depths, may migrate to the groundwater, surface water, the atmosphere, or may enter biological systems.

Soil samples may be collected using a variety of methods and equipment depending on the depth of the desired sample, the type of sample required (discrete or composite), and the soil type. Near-surface soils may be easily sampled using a spade, trowel, and/or scoop. Sampling at greater depths may be performed using a hand auger, continuous-flight auger, trier, split-spoon sampler, or, if required, a backhoe.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Samples must be cooled and maintained at 4°C and protected from sunlight immediately upon collection to minimize any potential reaction. The amount of sample to be collected, proper sample container type and handling requirements are discussed in the Scientific, Engineering, Response Analytical Services (SERAS) SOP #2003, *Sample Storage, Preservation and Handling.*

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

There are two primary problems associated with soil sampling: 1) cross contamination of samples, and 2) improper sample collection. Cross contamination problems can be eliminated or minimized through the use of dedicated sampling equipment. If this is not possible or practical, decontamination of sampling equipment is necessary. The guidelines for preventing, minimizing and limiting cross contamination of samples are discussed in the Environmental Response Team (ERT)/SERAS SOP #2006, *Sampling Equipment Decontamination* . Improper sample collection procedures can disturb the sample matrix, resulting in volatilization of contaminants, compaction of the sample, or inadequate homogenization of the samples (when required), resulting in variable, non-representative results.

5.0 EQUIPMENT/APPARATUS

Soil sampling equipment includes the following:

- Site maps/plot plan
- Safety equipment, as specified in the site-specific Health and Safety Plan (HASP)
- Traditional survey equipment or global positioning system (GPS)
- Tape measure
- Survey stakes or flags
- Camera and image collection media
- Stainless steel, plastic*, or other appropriate homogenization bucket, bowl or pan
- Appropriate size sample containers
- Ziplock plastic bags
- Site logbook
- Labels
- Chain of Custody records and custody seals
- Field data sheets and sample labels
- Cooler(s)
- Ice
- Vermiculite
- Decontamination supplies/equipment
- Plastic sheeting
- Spade or shovel
- Spatula(s)
- Scoop(s)
- Plastic* or stainless steel spoons
- Trowel(s)
- Continuous flight (screw) auger
- Bucket auger
- Post hole auger
- Extension rods
- T-handle
- Sampling trier
- Thin wall tube sampler
- Split spoon sampler
- Soil core sampler
  - Tubes, points, drive head, drop hammer, puller jack and grip
- Photoionization detector (PID), Flame ionization detector (FID) and/or Respirable Aerosol Monitor (RAM)
- Backhoe (as required)
- En Core® samplers

* Not used when sampling for semivolatile compounds.

6.0 REAGENTS

Decontamination solutions are specified in ERT/SERAS SOP #2006, *Sampling Equipment Decontamination*, and the site specific work plan.

7.0 PROCEDURES

7.1 Preparation

1. Determine the extent of the sampling effort, the analytes to be determined, the sampling methods to be employed, and the types and amounts of equipment and supplies required to accomplish the assignment.

2. Obtain the necessary sampling and air monitoring equipment.

3. Prepare schedules and coordinate with staff, client, and regulatory agencies, as appropriate.

4. Perform a general site reconnaissance survey prior to site entry in accordance with the site specific HASP.

5. Use stakes or flags to identify and mark all sampling locations. Specific site factors, including extent and nature of contamination, should be considered when selecting sample locations. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions. All staked locations should be utility-cleared prior to soil sampling; utility clearances must be confirmed before beginning intrusive work.

6. Pre-clean and decontaminate equipment in accordance with the site specific work plan, and ensure that it is in working order.

7.2 Sample Collection

7.2.1 Surface Soil Samples

The collection of samples from near-surface soil can be accomplished with tools such as spades, shovels, trowels, and scoops. The over-burden or over-lying surface material is removed to the required depth and a stainless steel or plastic scoop is used to collect the sample. Plastic utensils are not to be used when sampling for semivolatile compounds.

This method can be used in most soil types but is limited to sampling at or near the ground surface. Accurate, representative samples can be collected by this procedure depending on the care and precision demonstrated by the sample team member. A flat, pointed mason trowel to cut a block of the desired soil is helpful when undisturbed profiles are required. Tools plated with chrome or other materials must not be used.

The following procedure is used to collect surface soil samples:

1. If volatile organic compound (VOC) contamination is suspected, use a PID to monitor the sampler's breathing zone during soil sampling activities.

2. Using a pre-cleaned, stainless steel scoop, plastic spoon, or trowel, remove and discard sticks, rocks, vegetation and other debris from the sampling area.

3. Accumulate an adequate volume of soil, based on the type(s) of analyses to be performed, in

a stainless, plastic or other appropriate container.

4. If volatile organic analysis is to be performed, immediately transfer the sample directly into an appropriate, labeled sample container with a stainless steel spoon, or equivalent, and secure the cap tightly to ensure that the volatile fraction is not compromised. Thoroughly mix the remainder of the soil to obtain a sample that is representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly, or, if composite samples are to be collected, place a sample from another sampling interval or location into the homogenization container and mix thoroughly. When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.

7.2.2 Sampling at Depth with Augers and Thin Wall Tube Samplers

This system consists of an auger, head, a series of extensions, and a "T" handle (Figure 1, Appendix A). The auger is used to bore a hole to a desired sampling depth, and is then withdrawn. The sample may be collected directly from the auger head. If additional sample volume is required, multiple grabs at the same depth are made. If a core sample is to be collected, the auger head is then replaced with a tube auger. The system is then lowered down the borehole, and driven into the soil to the completion depth. The system is withdrawn and the core is collected.

Several types of augers are available; these include bucket or tube type, and continuous flight (screw) or post-hole augers. Bucket or tube type augers are better for direct sample recovery because a large volume of sample can be collected from a discrete area in a short period of time. When continuous flight or post-hole augers are used, the sample can be collected directly from the flights or from the borehole cuttings. The continuous flight or post-hole augers are satisfactory when a composite of the complete soil column is desired, but have limited utility for sample collection as they cannot be used to sample a discrete depth.

The following procedure is used for collecting soil samples with an auger:

1. Attach the auger head to an extension rod and attach the "T" handle.

2. Clear the area to be sampled of surface debris (e.g., twigs, rocks, litter). It may be advisable to remove a thin layer of surface soil for an area approximately six inches in radius around the sampling location.

3. Begin augering, periodically removing and depositing accumulated soils onto a plastic sheet spread near the hole. This prevents the accidental brushing of loose material back down the borehole when removing the auger or adding extension rods. It also facilitates refilling the hole, and avoids possible contamination of the surrounding area.

4. After reaching the desired depth, slowly and carefully remove the auger from the hole. When sampling directly from the auger head, proceed to Step 10.

5. Remove auger tip from the extension rods and replace with a tube sampler. Install the

proper cutting tip.

6. Carefully lower the tube sampler down the borehole. Gradually force the tube sampler into the soil. Do not scrape the borehole sides. Avoid hammering the rods as the vibrations may cause the boring walls to collapse.

7. Remove the tube sampler and unscrew the extension rods.

8. Remove the cutting tip and the core from the device.

9. Discard the top of the core (approximately 1 inch), as this possibly represents material collected before penetration of the layer of concern. Place the core or a discrete portion of the core into the appropriate labeled sample container using a clean, decontaminated stainless steel spoon. If required, homogenize the sample as described in Step 10.

10. If VOC analysis is to be performed, transfer the sample directly from the auger head into an appropriate, labeled sample container with a stainless steel spoon, or equivalent and secure the cap tightly.

11. If another sample is to be collected in the same hole, but at a greater depth, reattach the auger head to the drill assembly, and follow steps 3 through 11, making sure to decontaminate the auger head and tube sampler between samples.

12. Abandon the hole according to applicable state regulations.

7.2.3 Sampling at Depth with a Trier

The system consists of a trier and a "T" handle. The auger is driven into the soil to be sampled and used to extract a core sample from the appropriate depth.

The following procedure is used to collect soil samples with a sampling trier:

1. Insert the trier (Figure 2, Appendix A) into the material to be sampled at a zero degree to forty-five degree (0° to 45°) angle from the soil surface plane. This orientation minimizes the spillage of sample.

2. Rotate the trier once or twice to cut a core of material.

3. Slowly withdraw the trier, making sure that the slot is facing upward.

4. If VOC analyses are required, transfer the sample directly from the trier into an appropriate, labeled sample container with a stainless steel spoon, or equivalent device and secure the cap tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container and mix thoroughly to obtain a sample that is representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; if composite samples are to be collected, place a sample from another sampling interval into the

homogenization container and mix thoroughly. When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.

7.2.4 Sampling at Depth with a Split Spoon (Barrel) Sampler

Split spoon sampling is generally used to collect undisturbed soil cores of 18- or 24- inches in length. A series of consecutive cores may be extracted with a split spoon sampler to give a complete soil column profile, or an auger may be used to drill down to the desired depth for sampling. The split spoon is then driven to its sampling depth through the bottom of the augured hole and the core extracted.

When split spoon sampling is performed to gain geologic information, all work should be performed in accordance with American Society for Testing and Materials (ASTM) D1586-99, "*Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils*".

The following procedures are used for collecting soil samples with a split spoon:

1. Assemble the sampler by aligning both sides of the barrel and then screwing the drive shoe on the bottom and the head piece on top.

2. Place the sampler at a 90 degree (90 °) angle to the sample material.

3. Using a well ring, drive the sampler. Do not drive past the bottom of the head piece or compression of the sample will result.

4. Record in the site logbook or on field data sheets the length of the tube used to penetrate the material being sampled, and the number of blows required to obtain the sample.

5. Withdraw the sampler, and open it by unscrewing the bit and head, and then splitting the barrel. The amount of recovery and soil type shoul d be recorded on the boring log. If a split sample is desired, a cleaned, stainless steel knife should be used to divide the tube contents in half, longitudinally. This sampler is typically available in 2- and 3.5-inch diameter tubes. A larger barrel (diameter and/or length) may be necessary to obtain the required sample volume.

6. Without disturbing the core, transfer it to the appropriately labeled sample container(s) and seal tightly. Place the remainder of the sample into a stainless steel, plastic, or appropriate homogenization container, and mix thoroughly to obtain a sample that is representative of the entire sampling interval. Then, either place the sample into the appropriate, labeled containers and secure the caps tightly, or if composite samples are to be collected, place a sample from another sampling interval or location into the homogenization container and mix thoroughly. When compositing is complete, place the sample into the appropriate, labeled containers and secure the caps tightly.

7. Abandon the hole according to applicable state regulations.

7.2.5 Test Pit/Trench Excavation

A backhoe can be used to remove sections of soil when a detailed examination of stratigraphy and soil characteristics is required. The following procedures are used for collecting soil samples from test pits or trenches:

1. Prior to any excavation with a backhoe, it is imperative to ensure that all sampling locations are clear of overhead and buried utilities.

2. Review the site specific HASP and ensure that all safety precautions including appropriate monitoring equipment are installed as required.

3. Using the backhoe, excavate a trench approximately three feet wide and approximately one foot deep below the cleared sampling location. Place excavated soils on plastic sheets. Trenches greater than five feet deep must be sloped or protected by a shoring system, as required by Occupational Safety and Health Administration (OSHA) regulations.

4. A shovel is used to remove a one to two inch layer of soil from the vertical face of the pit where sampling is to be done.

5. Samples are taken using a trowel, scoop, or coring device at the desired intervals. Be sure to scrape the vertical face at the point of sampling to remove any soil that may have fallen from above, and to expose fresh soil for sampling. In many instances, samples can be collected directly from the backhoe bucket.

6. If VOC analyses are required, transfer the sample into an appropriate, labeled sample container with a stainless steel spoon, or equivalent and secure the cap tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval into the homogenization container and mix thoroughly. When compositing is complete, place the sample into the appropriate, labeled containers and secure the caps tightly.

7. Abandon the pit or excavation according to applicable state regulations.

7.2.6 Sampling for VOCs in Soil Using an En Core® Sampler

An En Core® sampler is a single-use device designed to collect and transport samples to the laboratory. The En Core® sampler is made of an inert composite polymer and reduces the open-air handling of soil samples in the field and in the laboratory; thereby, minimizing losses of VOCs.

1. Assemble the coring body, plunger rod and T-handle according to the instructions provided with the En Core® sampler.

2. Turn the T-handle with the T-up and the coring body down and push the sampler into the soil until the coring body is completely full. Remove the sampler from the soil. Wipe excess soil from the coring body exterior.

3. Cap the coring body while it is still on the T-handle. Push the cap over the flat area of the ridge. Be sure that the cap is seated properly to seal the sampler. Push and cap to lock arm in place.

4. Remove the capped sampler by depressing the locking lever on the T-handle while twisting and pulling the sampler from the T-handle.

5. Attach the label to the coring body cap, place in a plastic zippered bag, seal and put on ice.

Generally, three En Core® samplers are required for each sample location. These samplers are shipped to the laboratory where the cap is removed and the soil samples are preserved with methanol or sodium bisulfate.

8.0 CALCULATIONS

This section is not applicable to this SOP.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

There are no specific quality assurance (QA) activities that apply to the implementation of these procedures. However, the following general QA procedures apply:

2. All data must be documented in site logbooks or on field data sheets. At a minimum, the following data is recorded:

   Sampler's name and affiliation with project
   Sample number
   Sample location
   Sample depth
   Approximate volume of sample collected
   Type of analyses to be performed
   Sample description
   Date and time of sample collection
   Weather conditions at time of sampling
   Method of sample collection
   Sketch of sample location

2. All instrumentation must be operated in accordance with applicable SOPs and/or the manufacturer's operating instructions, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation, and must be documented.

3. The types of quality control (QC) samples to be collected in the field shall be documented in the site-specific Work Plan.

10.0 DATA VALIDATION

This section is not applicable to this SOP.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA and corporate health and safety procedures, in addition to the procedures specified in the site specific HASP.

12.0 REFERENCES

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U.S. Environmental Protection Agency. 1984. *Characterization of Hazardous Waste Sites - A Methods Manual: Volume II.* Available Sampling Methods, Second Edition. EPA-600/4-84-076.

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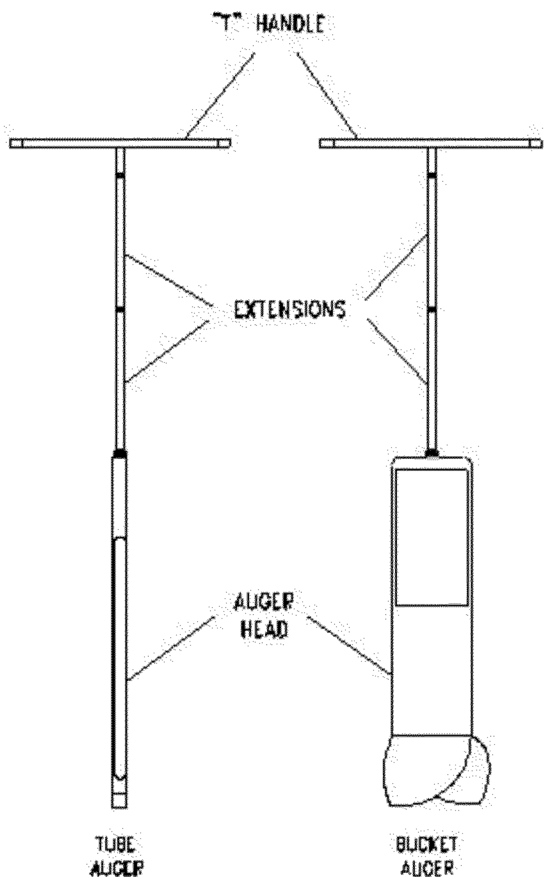
American Society for Testing and Materials. *Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils*. Method D 1586-99.

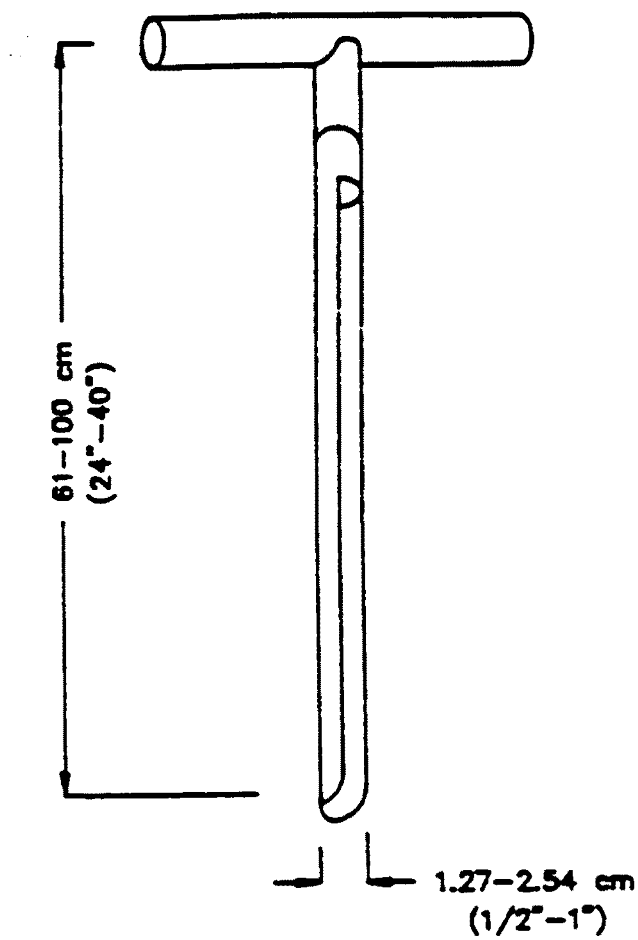
En Novative Technologies, Inc. 2001. *En Core® Sampler Sampling Procedures*. Web site access. March 13, 2001.

APPENDIX A
Figures
SOP #2012
July 2001

FIGURE 1. Sampling Augers



FI G
U RE
2. Sampling Trier


61–100 cm
(24"–40")
1.27–2.54 cm
(1/2"–1")